The first 300 sols of the SHERLOC investigation on the Mars 2020 rover. A. E. Murphy[10], L. W. Beegle[1], R. Bhartia[1,2], L. DeFlores[1], W. Abbey[1], J. Razzell Hollis[1], S. Asher[3], E. Berger[4], S. Bykov[3], A. Burton[4], A, Fox[4] M. Fries[4], P. Conrad[5], S. Clegg[6], K. S. Edgett[7], B. Ehlmann[8], L. Kah[9], C. Lee[4], M. Minitti[10], R. Roppel[3], S. Sharma[1], S. Siljeström[11] C. Smith[12], P. Sobron[13], A. Steele[5], R. Wiens[6], K. Williford[1], B. Wogsland[9], M. R. Kennedy[7], R. A. Yingst[10]. [1]Jet Propulsion Laboratory, California Institute of Technology, Pasadena Ca, 91109 (Luther.Beegle@jpl.nasa.gov), [2]Photon Systems Inc., [3]University of Pittsburgh, [4]Johnson Space Center, [5]Carnegie Institute Washington, [6]Los Alamos National Laboratory, [7]Malin Space Science Systems, [8]California Institute of Technology, [9]University of Tennessee-Knoxville, [10]Planetary Science Institute, [11]RISE Research Institutes of Sweden, Stockholm, Sweden, [12]Natural History Museum, London, [13]SETI Institute.

Introduction: The Mars2020 mission is NASA's latest flagship mission to Mars. The spacecraft launched in July 2020, and landed in Jezero crater on February 18, 2021 at the Octavia Butler Landing site. The rocks and sediments of Jezero crater have been argued to have preserved records of past, potentially habitable environments. The mission is characterizing the field site by analyzing chemistry, looking for organics and searching for potential biosignatures.

The Scanning Habitable Environments with Raman and Luminescence for Organics and Chemicals (SHERLOC) is a robotic arm mounted instrument. SHERLOC combines imaging with UV resonance Raman and native deep UV fluorescence spectroscopy to identify potential biosignatures and understand the aqueous history of the Jezero Region [1]. WATSON (Wide Angle Topographic Sensor for Operations and eNgineering), a refight of the Mars Hand Lens Imager (MAHLI) on the Curiosity rover is capable of color imaging over a wide range of resolutions (from infinity to 13.1 micron/pixel) and is used for both science and engineering. A second imager, the Autofocusing Contextual Imager (ACI), produces gray scale images at 10.1 micron/pixel resolution at a 48 mm range [1].

Goals of the SHERLOC investigation:

- *Assess the habitability potential of a sample and its aqueous history.*
- *Assess the availability of key elements and energy source for life (C, H, N, O, P, S etc.)*
- *Determine if there are potential biosignatures preserved in Martian rocks and outcrops.*
- *Provide organic and mineral analysis for selective sample caching.*

To do this SHERLOC *detects* and *classifies* organics and astrobiologically relevant minerals on the surface and near subsurface of Mars with the following specifications:

- Bulk organic sensitivity of 10^{-5} to 10^{-6} w/w over an 7 x 7 mm spot.
- Fine scale organic sensitivity of 10^{-2} to 10^{-4} w/w spatially resolved at <100μm
- Astrobiologically Relevant Mineral (ARM) detection and classification to <100μm resolution

Science Overview: During the first 300 sols on Mars, SHERLOC data have been used to identify phosphates, sulfates, carbonates, perchlorates, olivine, and amorphous (glass-like) or microcrystalline silicate phase(s) in abraded rock patches created during the Crater Floor Campaign within Jezero crater. Fluorescence observed on abraded sample surfaces is usually spatially correlated with minerals. Within these detections we have observed evidence of past water interaction with these rocks.

Results: As of Sol 300, we have explored 5 different abraded rock patches. Although other payload instruments (e.g., PIXL) may have observed the same targets (Fig. 1), we present here only the observations from SHERLOC.

The Guillaumes target is dominated by Ca-sulfate with patches of perchlorate. The presence of perchlorate indicates these rocks have undergone aqueous alteration and this material was either emplaced after being created in atmospheric processes, or is indigenous to the sample through processes described elsewhere [7].

The Bellegarde target exhibits Raman peaks that match hydrated Ca-sulfate, amorphous/microcrystalline silicate, carbonate, and phosphate phases. Collocated 300 and 325 nm fluorescence spectral features with sulfate phases observed within the target may be aromatic ring organics [8] or fluorescence from lanthanides [9].

The Garde target is dominated by olivine and carbonate with amorphous silicate occurring in association with both mineral phases. This association suggests that primary olivine may have undergone carbonation, an aqueous alteration that produces carbonate and amorphous/microcrystalline silicate phases [10]. Additionally, localized 290 and 335 nm fluorescence spectral features are observed along the olivine and carbonate grain boundaries. The association of fluorescent spectral features with grain boundaries is suggestive of aqueous alteration where fluids alter minerals during diagenesis or metamorphism.

The Dourbes target (Fig. 1) is dominated by olivine and shows minor amounts of carbonate, hydrated Ca-sulfate, and amorphous/microcrystalline silicate (Fig. 2). Fluorescence features (330-340 nm) are detected in discrete spots and do not appear to be associated with minerals.

The Quartier target exhibits a large sulfate feature (white feature in Fig. 3), as well as carbonate, perchlorate, olivine and potential organic graphitic carbon band (weak G-band at ~1640 cm^{-1}) that appears to be associated with sulfate and a fluorescence doublet at 290 and 330 nm.

Summary: The presence of perchlorates (Guillaumes) and the association of amorphous/microcrystalline silicate with olivine/carbonate phases (Garde) suggests aqueous alteration of the rocks analyzed in "crater floor" rock units and in the rock outcrops of Seitah in Jezero crater.

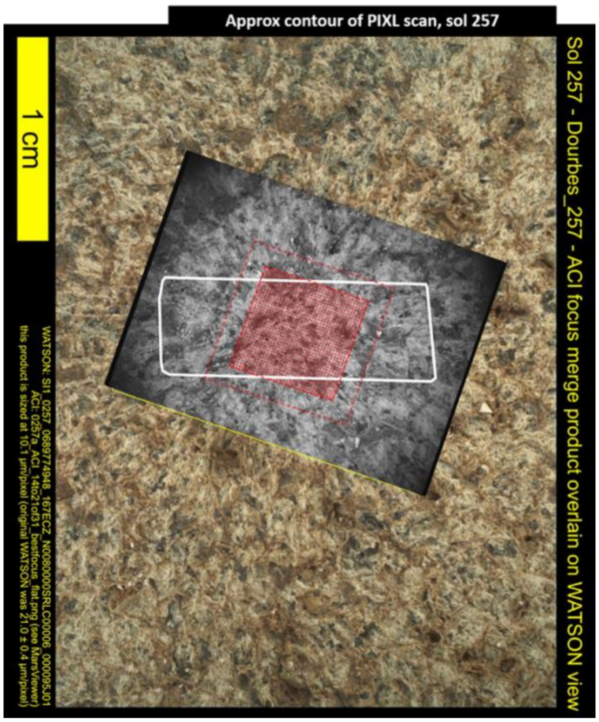

Fig. 1 Color WATSON image of the Dourbes abraded patch with the gray scale ACI overlay. The SHERLOC Survey scan is indicated by red dots, with the PIXL overlay in white.

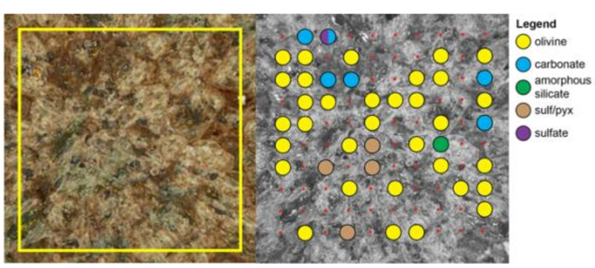

Fig. 2 WATSON image (left) of Dourbes target where yellow box denotes SHERLOC scan area (right). Gray scale ACI with mineral identification (see legend) overlay.

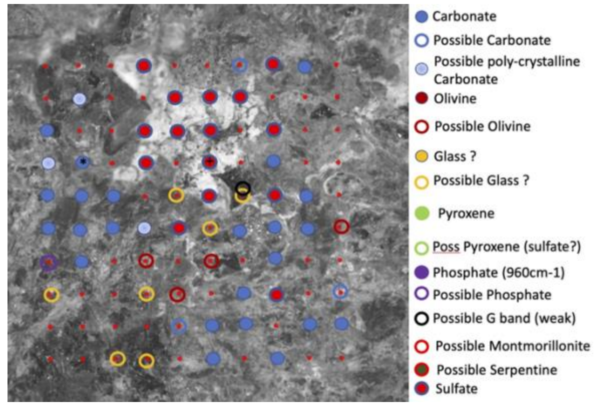

Fig. 3 Gray scale ACI with mineral identification (see legend) overlay in the Quartier target.

Acknowledgments: This work was carried out at the Jet Propulsion Laboratory, The California Institute of Technology under a contract from NASA.

References: [1] Beegle, L. W. et al. (2015) *IEEE, 90*, 1-11.; Bhartia, R. et al. (2021) *Space Sci. Rev., 217*, 58 [2] Abbey, W. J. et al. (2017) *Icarus*, *290*, 201-214. [3] Sapers, H. et al. (2019) *Front. Microbiol.*, *10* [4] Razzell Hollis, J. et al. (2019) *App. Spec.*, in press. [5] Razzell Hollis, J. et al. (2020) Submitted to Icarus. [6] Bhartia, R. et al. (2008) *App. Optics*, *62* (10). [7] Steele, A. et al. (2018) *Sci. Adv., 4*. [8] Scheller, E. L. et al. (2022) LPSC. [9] Shkolyar, S. et al. (2021) *Icarus*, *354*, 114093. [10] Smith, B. et al. (2022) LPSC.