Title: SHERLOC: Results of the first 350 sols of operations

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Abstract: On February 18th 2021, the Perseverance rover landed in Jezero crater, Mars. This site was chosen because orbiter data analysis provides evidence that the crater hosted a stream-fed lake during the Martian Noachian period. The Octavia Butler landing site is located ~1.9 km east of the remnants of a river delta. Deltaic and lacustrine sediments can preserve biosignatures, making Jezero crater a prime target for Mars sample return science. One of the seven instruments on Perseverance's science payload is SHERLOC –Scanning Habitable Environments with Raman and Luminescence for Organics and Chemicals.

SHERLOC combines fluorescence and Raman spectroscopy with microscopic imaging to analyze surface material to better understand the history of the aqueous environments recorded in the rocks of Jezero crater and to search for potential biosignatures. SHERLOC imaging obtains high spatial resolution images of geological targets to identify grain-scale structure and texture.

SHERLOC spectroscopy enables high-sensitivity detection, characterization, and spatially-resolved correlation of trace organic materials. Native fluorescence emissions from aromatic organic species allow for detection and classification of aromatic organic molecules, whereas Raman scattered photons from molecules allow identification of functional groups of organics, chemicals, and minerals.

In the first 300 sols, SHERLOC has analyzed 3 natural surfaces, and 5 abraded rock patches created during the Crater Floor Campaign within Jezero crater. SHERLOC has been able to identify phosphates, amorphous/microcrystalline silicate (AMS), olivine, sulfates, and carbonates in abraded patches in the green zone campaign within Jezero Crater Máaz and

Séítah formations. Within these detections we have begun to tell the story of what this crater was like when it was full of liquid water over 3 billion years ago.

In each of these samples we have identified fluorescence features that are likely aromatic organics native to the rock interiors. We have identified multiple unique fluorescence signatures, within each of the abraded patches. The organic signatures have either been widely distributed over an extended area, which is probably due to planetary wide dust, or have spatially resolved locations that are collocated with different mineral signatures.

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References: [1] Bhartia, R. et al. (2021) *Space Sci. Rev., 217*, 58 [2] Farley et al. (2022) submitted to Science; Scheller et al. (2022) submitted to Science.