

EGU24-8479, updated on 15 Jul 2024

<https://doi.org/10.5194/egusphere-egu24-8479>

EGU General Assembly 2024

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## Spectroscopy on Mars with NASA Perseverance rover

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The NASA Perseverance rover is exploring Jezero crater on Mars since february 2021 [1]. Perseverance's main goal is to investigate the past geologic and environmental conditions of Jezero crater and seek evidence of past life. For this, the rover has characterized the local geology of the crater floor and is presently working in an ancient river delta. Then, Perseverance will explore the crater rim, and possibly some regions outside of the crater. In addition, the rover selects and collects the most compelling samples that will be retrieved and brought back to Earth by a future mission (NASA/ESA Mars Sample Return project) for more detailed study.

Perseverance uses a panel of spectroscopic tools based on the analysis of sunlight reflectance in the visible and near-infrared domains (MastcamZ, SuperCam), deep-UV (SHERLOC) and time-resolved (SuperCam) Raman, Laser Induced Breakdown Spectroscopy - LIBS (SuperCam) and X-ray fluorescence (PIXL). Some instruments can analyze the chemistry and mineralogy of rocks remotely up to several meters [2-3] while others work close to the rock for higher spatial resolution (~100 mm) and better textural control [4-5]. The rover is operated nearly every day and sends data almost immediately to Earth.

On the crater floor, Perseverance found igneous rocks: basaltic lava or pyroclastic flows [6] covering an olivine-rich cumulate [4,7]. The magmatic mineral assemblage, including the textural relationships, was carefully described: mostly Fe-rich pyroxenes in the basaltic flows, and a cumulate composed of dominant olivine with augite and pigeonite, as well as some phosphates and (Cr-)Ti-Fe-oxides in both units. The bulk of these rocks is weakly altered but Fe-Mg carbonates [8], sulfates [5] and various phyllosilicates [9] were detected showing that fluid-rock interactions locally occurred. After the crater floor, Perseverance began exploring the sedimentary rocks in the Jezero western fan, which is still in progress. On the fan, some float rocks show intense alteration to kaolinite followed by metamorphism [10].

Perseverance instruments which have an original design optimized for lightness, resistance to extreme conditions and performance will be introduced. Doing spectroscopy on Mars is challenging but these instruments have worked perfectly so far. A large amount of data, including some first-time achievements on Mars, have been collected and will be summarized with special emphasis on spectroscopic data.

[1] Farley et al., Science, 2022 ; [2] Bell et al., Science Advances, 2022 ; [3] Wiens et al., Sciences Advances, 2022 ; [4] Liu et al., Science, 2022 ; [5] Scheller et al., Science, 2022 ; [6] Udry et al., JGR

Planets, 2023 ; [7] Beyssac et al., JGR Planets, 2023 ; [8] Clavé et al., JGR Planets, 2023 ; [9] Mandon et al., JGR Planets, 2023 ; [10] Royer et al., LPSC 2024.