

Calibration and validation of the SHERLOC instrument operating in Jezero crater, Mars

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The Scanning Habitable Environments with Raman and Luminescence for Organics and Chemistry (SHERLOC) is an instrument onboard the Mars 2020 Perseverance rover. It consists of a spectrometer that measures deep ultraviolet (DUV) resonance Raman and native fluorescence photons generated through surface interactions with a 248.6 nm pulsed laser. Two microscopic imagers, the Autofocus Context Imager (ACI) and the Wide-Angle Topographic Sensor for Operations and eNginneering (WATSON), provide high-resolution context images of SHERLOC targets. The ACI is co-boresighted with the spectrometer. To ensure proper calibration, the SHERLOC calibration target (SCT) is mounted on the front of the rover and consists of ten different materials.

The SCT was designed, fabricated, assembled, and tested by Jacobs Technology, Inc., and NASA Johnson Space Center. The dimensions of the calibration target housing are 150 x 89 x 33 mm and it weighs ~437 g. The ten targets are arranged in two rows; the first six are hard targets (AlGa_N for Raman and fluorescence, diffuse transmission target, a slice of the SaU008 Mars meteorite, an intensity maze, and polycarbonate over geocache coin) and the remaining four are soft-goods targets (Vectran, Ortho-Fabric, Teflon, and nGimat-coated Teflon). The hard targets calibrate the spectrometer's Raman and fluorescence spectral accuracy, ambient light reflection, and Raman response curve, while the soft-goods targets are spacesuit materials that function as human exploration targets, some of which are also used for spectral calibration. SHERLOC also has an internal calibration target consisting of AlGa_N on sapphire (275 nm) located inside the ACI opaque dust cover to ensure proper instrument functioning between calibration target analyses.

Initial SHERLOC, ACI, and WATSON calibration and validation on Mars was performed using the internal calibration target on sols 59, 83, 98, and 141; WATSON imaging of the SCT on sols 26 and 62, and SHERLOC spectroscopy and ACI imaging of the SCT on sol 59. These early data provide initial insights into instrument performance and the stability and degradation of the calibration target materials relative to the Martian surface and dust environment. Early observations also have implications for future astronaut spacesuit materials.