

ROCK COATINGS IN JEZERO CRATER AS OBSERVED BY THE PERSEVERANCE ROVER. A. M. Ollila¹, N. Lanza¹, B. Garczynski², S. Theuer², M. E. Schmidt³, B. Chide⁴, C. Bedford⁵, P. Gasda¹, O. Forni⁴, A. Cousin⁴, E. Dehouck⁶, R. Wiens⁵, S. Maurice⁴, O. Gasnault⁴, M. Nachon⁷, J. Johnson⁸, S. Clegg¹, P. Beck⁹, A. Zastrow¹, S. Schroder¹⁰, G. Arana¹¹, J.M. Madariaga¹¹. ¹Los Alamos National Laboratory, Los Alamos, NM, USA (amo@lanl.gov), ²Western Washington University, Bellingham, WA, USA, ³Brock University, St. Catharines, Ontario, Canada, ⁴IRAP, Toulouse, France, ⁵Purdue University, West Lafayette, IN, USA, ⁶Université Claude Bernard Lyon 1, Villeurbanne, Auvergne-Rhône-Alpes, France, ⁷Texas A&M University, ⁸JHU/APL, Laurel, MD, USA, ⁹IPAG, Université Grenoble Alpes, ¹⁰DLR, Berlin, Germany, ¹¹UPV/EHU, Leioa, Spain.

Introduction: Topographically smooth, discontinuous layers on float and outcrop rocks have been observed by the Perseverance rover instruments at numerous locations in Jezero crater and have been interpreted as rock coatings. Coatings are formed by the accretion of material on a rock surface through interaction with the environment. Most often, the composition of the coating is unrelated to the substrate on which it forms [1]. In Jezero, two types of likely coatings have been identified including purple to gray hued [2-5; Fig. 1b-d] of variable thickness and Mn-rich [6; Fig. 1a]. The thin purple-toned and thicker dark gray-toned coatings may represent members in a continuum signifying differing formation and/or exposure times [3] and are discussed together here.

SuperCam has analyzed several of coatings using Laser-Induced Breakdown Spectroscopy (LIBS), LIBS acoustics, and visible/near-infrared (VISIR) spectroscopy [7, 8]. MastCam-Z has observed numerous coatings using multi-spectral imaging [3, 4] and PIXL has analyzed several coatings throughout the traverse [9].

Diverse Suite of Coatings:

Purple/gray-toned Coatings: Purple/gray colored coatings have been widely observed both on the crater floor and on the Jezero delta. These coatings have been observed on most rock types, suggesting that the composition of the substrate is unrelated to the coating material. The compositions of these coatings are similar to martian dust/fine regolith mixed with sulfates and ferric oxides [3]. A combined SuperCam RMI-

LIBS-acoustics analysis of a purple coating on the target Cordocel is shown in Figure 2. The LIBS and acoustics data show a change in trends around shot 50, with the acoustics data indicating the coating is softer than the substrate and chemistry data indicating that the coating is similar in composition to the martian dust/regolith. PIXL identified an enrichment in ZnO, SO₃, and Cl relative to Mars global dust, suggesting the presence of salts [9]. These mineral mixtures could suggest coating formation via atmospheric water-rock interactions (common on Earth), widespread subsurface aqueous interaction with regolith soils [3], or deposition from a vapor plume, degassing, or impacts [9].

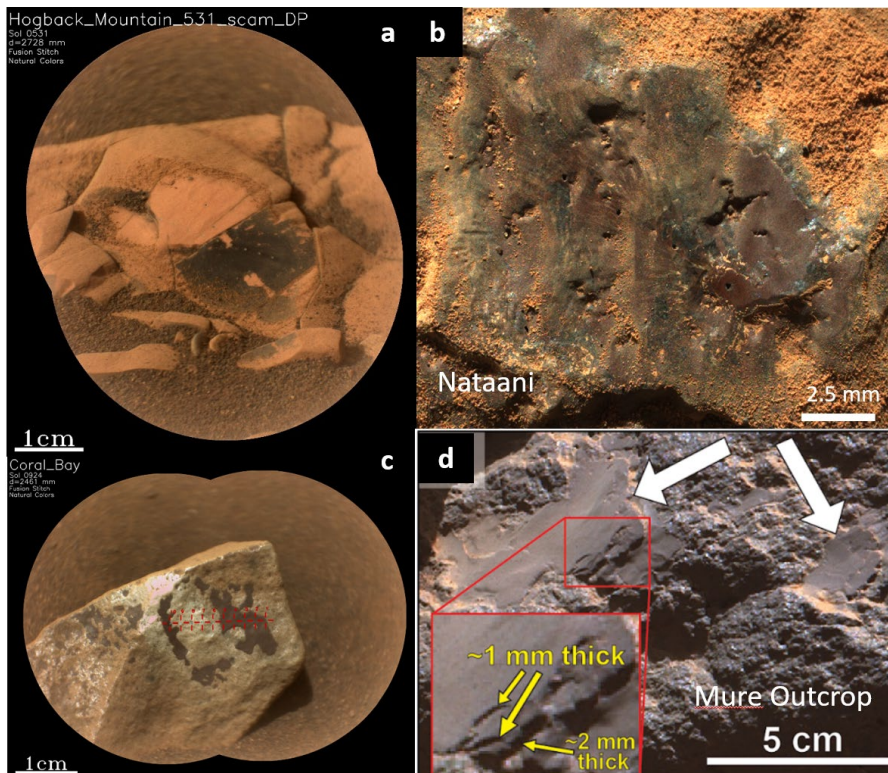


Figure 1: Examples of the different types of coatings identified in Jezero crater. (a) SuperCam Remote Micro Image (RMI) of Hogback_Mountain Mn-rich coating, (b) WATSON image of the Nataani purple coating, (c) dark purple coating on Al-rich light-toned rock Coral_Bay, and (d) MastCam-Z image of a thick, gray coating on the Mure outcrop from [3].

Mn-rich Coatings. These types of coatings appear to be relatively rare in Jezero. SuperCam has made one observation of this dark material on the target Hogback_Mountain (Fig. 1a) in the Hogwallow Flats region deltaic sediments. The LIBS data from SuperCam indicate that it is enriched in MnO (up to 30 wt%) and the VISIR reflectance spectra suggest the presence of phyllosilicates and Mn-rich minerals such as birnessite [2]. Other dark-toned coatings are present in Mast-Cam-Z multispectral images along the traverse but no chemical information is available to confirm the presence of elevated Mn [2]. The Hogback_Mountain observation is particularly exciting given that it appears to be similar to terrestrial rock varnishes, which form in desert environments. Recent studies indicate microbes are directly involved in their formation [10], making the Mn-rich coatings observed in Jezero particularly significant targets for sample return.

Conclusions and Future Work: The Mn-rich coating is intriguing due to its similarity to terrestrial rock varnishes, which likely involve microbes in their formation [10]. More analyses of both the purple/gray-toned and Mn-rich coatings are needed to identify the minerals present, to help distinguish between the various formation hypotheses, and monitor for changes in composition throughout the crater.

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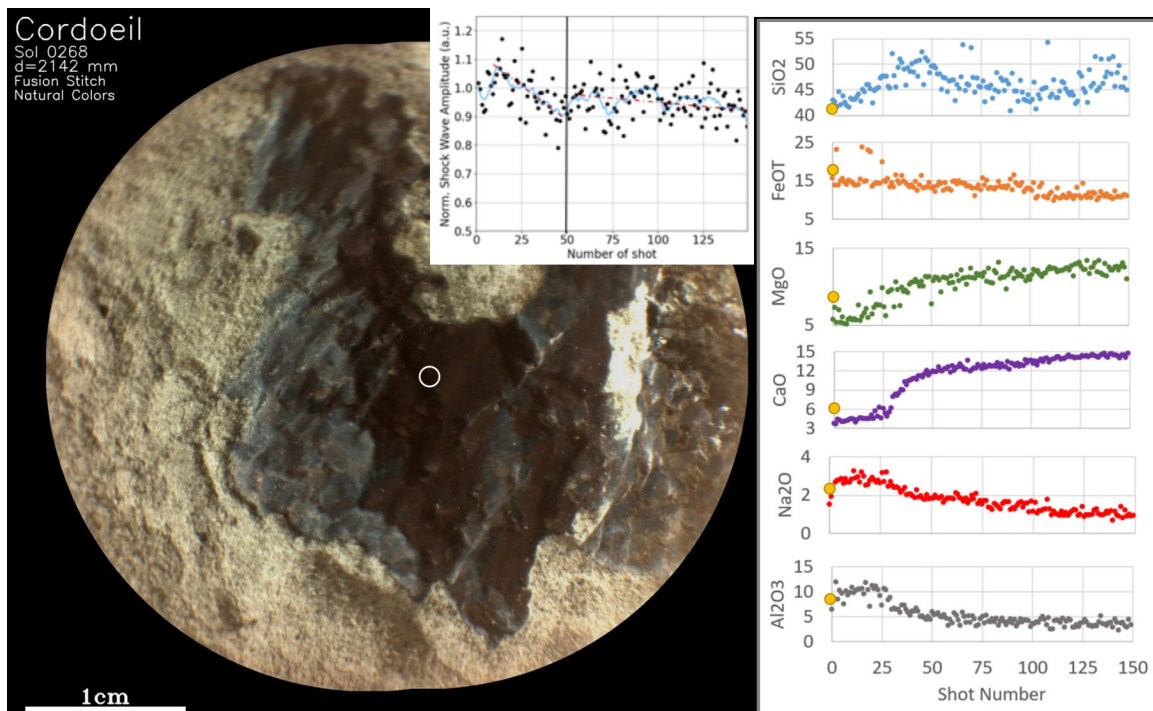


Figure 2: SuperCam analysis of Cordoel. Point 1 (circled in the RMI) showed distinct chemical (in wt.%, right) and acoustic trends (inset over the RMI) with inflection points occurring around shot 50. The steep initial slope in the acoustic data followed by a shallower slope indicates the coating is softer than the substrate, an olivine rich rock. Yellow circles positioned at shot 0 in the compositions plots are average Mars dust/soil compositions from [11, 12]