Mars 2020
PDS Archive
Overview

Version 3.0

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Contents

Tables

Change Log

Date	Version	Section	Change
November 18, 2021	2.0	Table 4	Revised to show separation of camera data into multiple smaller bundles
November 18, 2021	2.0	Table 7	Release schedule revised for deliveries 3 times per year
March 22, 2022	3.0	Table 4	Corrected names of rover_places, helicam, and mastcamz_sci_calibrated bundles

Acronyms, Abbreviations, and Frequently Used Terms

ACI	Autofocus Context Imager (camera on SHERLOC)
ATM	PDS Atmospheres Node
CDR	Calibrated Data Record
CIS	PDS Cartography and Imaging Sciences Node
DDR	Derived Data Record
DUV	Deep Ultra Violet
EDR	Experiment Data Record
FFI	Forsvarets Forskning Institute, Norway
FOV	Field Of View
GEO	PDS Geosciences Node
GPR	Ground-Penetrating Radar
Hazcam	Hazard Camera
ISRU	In-Situ Resource Utilization
LIBS	Laser-Induced Breakdown Spectroscopy (spectrometer on SuperCam)
LID	Logical Identifier
Mastcam-Z	Mast-mounted multispectral stereoscopic imaging system
MEDA	Mars Environmental Dynamics Analyzer
MIT	Massachusetts Institute of Technology
MOXIE	Mars Oxygen In-Situ Resource Utilization Experiment
NAIF	Navigation and Ancillary Information Facility (a PDS Node)
Navcam	Navigation Camera
PDS	Planetary Data System
PDS4	Planetary Data System Archive Standard 4
PI	Principal Investigator
PIXL	Planetary Instrument for X-Ray Lithochemistry
Raman	Raman spectrometer on SuperCam
RDR	Reduced Data Record
RGB	Red-Green-Blue
RIMFAX	Radar Imager for Mars Subsurface Experiment
RMI	Remote Micro-Imager (camera on SuperCam)
SDD	Silicon Drift Detectors
SHERLOC	Scanning Habitable Environments with Raman and Luminescence for Organics and Chemicals
SIS	Software Interface Specification
SPICE	Spacecraft, Planet, Instrument, Camera matrix, Experimenter's notebook (historical acronym for the Observation Geometry System for Space Science Missions used by NAIF)
SuperCam	Instrument with multiple integrated spectrometers and camera
TRLS	Time-Resolved Fluorescence Spectroscopy (spectrometer on SuperCam)
VISIR	Visible/Infrared spectrometer on SuperCam
WATSON	Wide Angle Topographic Sensor for Operations and eNgineering (camera on SHERLOC)
XML	eXtended Markup Language
XRF	X-Ray Fluorescence

1 Introduction

1.1 Purpose and Scope

This document provides an overview of the Planetary Data System (PDS) archives of data from the Mars 2020 Perseverance Rover mission. The archives contain raw and reduced data, documents, and ancillary information.

This document includes a high level description of the Perseverance Rover payload, a high level description of the contents of the PDS archives, and a detailed list of all Mars 2020 archive components. Important PDS elements such as bundles, collections, labels, and dictionaries are described, with references to other documents for more detail. The schedule for public releases of Mars 2020 data is given, along with a list of online resources for locating the data.

The intended audience for this document are the science users of Mars 2020 data and documents.

1.2 Applicable Documents

1.2.1 Mission and Instrument Papers

[1] Allwood, A.C., Wade, L.A., Foote, M.C. et al. PIXL: Planetary Instrument for X-Ray Lithochemistry. Space Sci Rev 216, 134, doi: 10.1007/s11214-020-00767-7 (2020).

[2] Bhartia, R., L.W. Beegle, et al., Perseverance's Scanning Habitable Environments with Raman and Luminescence for Organics and Chemicals (SHERLOC) Investigation. Space Sci Rev 217, 58, doi: 10.1007/s11214-021-00812-z (2021).

[3] Farley, K.A., Williford, K.H., Stack, K.M. et al. Mars 2020 Mission Overview. Space Sci Rev 216, 142, doi: 10.1007/s11214-020-00762-y (2020).

[4] Hamran, SE., Paige, D.A., Amundsen, H.E.F. et al. Radar Imager for Mars' Subsurface Experiment—RIMFAX. Space Sci Rev 216, 128, doi: 10.1007/s11214-020-00740-4 (2020).

[5] Hecht, M., Hoffman, J., Rapp, D. et al. Mars Oxygen ISRU Experiment (MOXIE). Space Sci Rev 217, 9, doi: 10.1007/s11214-020-00782-8 (2021).

[6] Kinch, K.M., Madsen, M.B., Bell, J.F. et al. Radiometric Calibration Targets for the Mastcam-Z Camera on the Mars 2020 Rover Mission. Space Sci Rev 216, 141, doi: 10.1007/s11214-020-00774-8 (2020).

[7] Maki, J.N., Gruel, D., McKinney, C. et al. The Mars 2020 Engineering Cameras and Microphone on the Perseverance Rover: A Next-Generation Imaging System for Mars Exploration. Space Sci Rev 216, 137, doi: 10.1007/s11214-020-00765-9 (2020).

[8] Moeller, R.C., Jandura, L., Rosette, K. et al. The Sampling and Caching Subsystem (SCS) for the Scientific Exploration of Jezero Crater by the Mars 2020 Perseverance Rover. Space Sci Rev 217, 5, doi: 10.1007/s11214-020-00783-7 (2021).

[9] Pla-García, J., Rafkin, S.C.R., Martinez, G.M. et al. Meteorological Predictions for Mars 2020 Perseverance Rover Landing Site at Jezero Crater. Space Sci Rev 216, 148, doi: 10.1007/s11214-020-00763-x (2020).

[10] Stack, K.M., Williams, N.R., Calef, F. et al. Photogeologic Map of the Perseverance Rover Field Site in Jezero Crater Constructed by the Mars 2020 Science Team. Space Sci Rev 216, 127, doi: 10.1007/s11214-020-00739-x (2020).

[11] Wiens, R.C., Maurice, S., Robinson, S.H. et al. The SuperCam Instrument Suite on the NASA Mars 2020 Rover: Body Unit and Combined System Tests. Space Sci Rev 217, 4, doi: 10.1007/s11214-020-00777-5 (2021).

1.2.2 Archive Documentation

Mars 2020 archives include several types of documentation. See section 4.4, Documentation.

1.2.3 PDS References

[12] PDS4 Concepts Document, version 1.16.0.0, April 21, 2021, https://pds.nasa.gov/datastandards/documents/concepts/.
[13] Planetary Data System Standards Reference, version 1.16.0.0, April 21, 2021, https://pds.nasa.gov/datastandards/documents/sr/.
[14] Planetary Data System Data Provider's Handbook, version 1.16.0.0, April 21, 2021, https://pds.nasa.gov/datastandards/documents/dph/.
[15] PDS4 Common Data Dictionary, Abridged, version 1.16.0.0, April, 2021, https://pds.nasa.gov/datastandards/documents/dd/.
[16] PDS4 Information Model Specification, version 1.16.0.0, April, 2021, https://pds.nasa.gov/datastandards/documents/im/.

PDS4 is the name of the current PDS archive standard, described in above documents. The PDS4 Information Model, on which these documents are based, is revised about every six months, and the documents are revised accordingly. The most recent versions may be found at https://pds.nasa.gov/datastandards/documents/. The PDS4 products in the Mars 2020 archives have been designed based on the versions current at the time, which are those listed above.

2 Mars 2020 Mission Overview

The goals of the Mars 2020 mission are to seek signs of life and to collect rock and soil samples for a possible future return to Earth. The Perseverance Rover explores the landing site and acquires imaging, spectroscopy, and other measurements to characterize Martian soils, rocks, atmosphere, and other aspects of the environment. Perseverance carries seven scientific instruments and a sample acquisition and caching system. The various payload elements are used as an integrated suite of tools to characterize the local geology, to study particular rock and soil targets, to characterize the local environment, and to acquire and cache selected rock and soil samples. The prime mission for the rover is expected to be 836 sols (approximately 2.5 Earth years), with the possibility of an extended mission of unknown duration after that.

The seven science instruments can be classified into the following groups. Table 1 lists key aspects of each science investigation.

Remote sensing: Mounted on the top of a mast are the Mastcam-Z multispectral, stereoscopic imaging system with zoom capability provided by Arizona State University (PI: James Bell); SuperCam, a suite of six instruments in one including a laser-induced breakdown spectrometer, Raman spectrometer, Time-Resolved Fluorescence spectrometer, visible and infrared spectrometer, remote micro-imager, and microphone provided by Los Alamos National Laboratory (PI: Roger Wiens); and mounted on the body of the rover is RIMFAX, a ground-penetrating radar (GPR) provided by Forsvarets Forskning Institute (FFI), Norway (PI: Svein-Erik Hamran).

Proximity science: On the end of the robotic arm are PIXL, a microfocus X-ray fluorescence instrument provided by the Jet Propulsion Laboratory (PI: Abigail Allwood), and SHERLOC, Deep UV (DUV) resonance Raman and fluorescence spectrometer provided by the Jet Propulsion Laboratory (PI: Luther Beegle). Both proximity science instruments have mapping capabilities supported by their own integrated imagers. In addition, SHERLOC includes a second imager (WATSON) to be used for science and engineering purposes with high spatial resolution, color, and infinity focus.

Environmental measurements: Mounted on the mast is MEDA, a meteorology package provided by the Centro de Astrobiología/ Instituto Nacional de Tecnica Aeroespacial (PI: José Antonio Rodríguez-Manfredi).

In-situ resource utilization: Mounted on the rover body is MOXIE, a demonstration of In-Situ Resource Utilization (ISRU) technologies provided by the Massachusetts Institute of Technology (MIT) (PI: Michael Hecht).

Technology demonstration: The Mars 2020 rover carries a helicopter as a technology demonstration. The helicopter will fly up to 5 times over a ~30 sol period early in the mission. The helicopter carries two cameras, one for navigation and one for capturing aerial views for science evaluation. The images are stored onboard during flight, and then are transmitted to the rover afterwards for relay to Earth.

Table 1. Key Aspects of the Perseverance Payload

Investigation	Key Parameters	Science Measurements
Mastcam-Z	Mastcam-Z consists of two matched cameras, Mastcam-Left and Mastcam-Right with a 3.6:1 zoom range (28mm to 100mm). Both have an integrated RGB Bayer pattern filter integrated over their detector for natural color plus narrow-band filters (430-1085nm range) for scientific color. 1600 × 1200 pixel images. At the narrowest field of view (100mm), the cameras have 7.4 cm/pixel scale at 1 km distance and ~150 µm/pixel scale at 2 m distance. At the widest field of view (28mm), the cameras have a 532 µm/pixel scale at 2 m distance and 27 cm/pixel at 1 km. HD video at ~4 frames per second, 1280 × 720 pixels.	Observations of geologic structures and features. Studies of landscape, rocks, fines, soils, frost/ice, and atmospheric features.
SuperCam (remote-sensing composition and high-resolution imaging)	Laser-induced breakdown spectroscopy (LIBS) measurements made from a distance of up to 7 meters; 240-850 nm spectral range, 14-bit dynamic resolution over 8194 channels. Dust removal over a ~1 cm diameter region. Raman spectroscopy measurements made from a distance of up to 12 meters; 150-4400 cm-1 spectral range at better than 10 cm-1 resolution; Time-resolved fluorescence with better than 25 ns adjustable time resolution. High-resolution color context imaging with a > 15 mrad field of view and < 0.020 mrad pixel resolution. Microphone to measure the pressure wave produced by the generation of plasma at a LIBS target.	Rapid chemical and mineralogical composition of rocks and soils and high-resolution color imaging from a distance.

Investigation	Key Parameters	Science Measurements
Hazcams (Hazard Cameras)	Color stereo imaging in front of rover and rear of rover, 0.4 mrad IFOV, 90°x120° FOV; 5120x3840 pixel images.	Imaging used for hazard avoidance during traverses and robotic arm deployment support. Also useful as science imaging of rocks and soils, targeted remote sensing
Helicopter	Navcam: 640x480 pixel 8-bit grayscale images pointing straight down from the belly of the helicopter. Return to Earth camera: 4224x3120 pixel 8-bit color images. Mounted on the side of the helicopter facing downward at an angle to see both nadir and horizon.	Imaging used by onboard navigation software to determine helicopter position and attitude and to help navigate.
Navcams (Navigation Cameras)	Color stereo imaging on Remote Sensing Mast (RSM), 360 degree azimuthal field of regard, +/90 degrees elevation, 0.3 mrad IFOV, 70°x90° FOV; 5120x3840 pixel images.	Imaging used for planning rover traverses and targeted remote sensing. Also useful as science imaging of geologic structures and features, rocks, and soils.
PIXL (Planetary Instrument for X-ray Lithochemistry)	Microfocus X-ray fluorescence (XRF) spectroscopy using a Rh X-ray tube, a polycapillary focusing optic, and energy-dispersive Silicon Drift Detectors (SDD) to provide an X-ray spectral range from <1 keV to 28 keV. Measures abundances of 23 elements with a spatial resolution of 125 um at a distance of 3 cm. Micro-context camera images register element distributions to visual features.	Abundances and sub-millimeter-scale distribution of elements in relation to rock/soil texture and microstructure.
SHERLOC (Scanning Habitable Environments with Raman and Luminescence for Organics and Chemicals)	Laser Raman spectroscopy and imaging measurements taken from a distance of ~30 mm. 50 um beam diameter, 30 um depth of penetration, 7 f-number collection aperture. Single in-focus 2D, 11 bit context-imaging. DUV fluorescence/Raman spectra from an average over 49, 1 x 1 mm areas over a 7 x 7 mm FOV. 2048 x 1 pixel data products for each point of a 400 point 50 µm/pixel map over a nominal 1 x 1 mm surface.	Non-contact, spatially resolved, and highly sensitivity detection and characterization of organics and minerals in the Martian surface and near subsurface.
MOXIE (Mars Oxygen In-Situ Resource Utilization Experiment)	Technology Demonstration: In situ resource utilization of Martian atmospheric CO_2, which is collected and delivered at 1 atm of pressure to a solid oxide electrolyzer operating at 800 °C that electrochemically generates O_2. The science measurements will characterize MOXIE performance on Mars to inform next generation, scaled up designs.	Effluent waste and product stream composition to determine oxygen production rate and purity; CO_2 flow rate; and temperature, voltage and current of the electrolyzer.

Investigation	Key Parameters	Science Measurements
MEDA (Mars Environmental Dynamics Analyzer)	Variable sampling rate acquisitions (max 2Hz) at regular intervals of: Air temperature (range 150K-300K). Pressure (1-1200Pa). Humidity (1-100% RH). Vertical and 2-D horizontal wind speed (0-70m/s). Downward sky IR radiation (bands 6-35,14.5-15.5 microns, overall temp range 173K-293K) and upward surface IR radiation (6-35, 8-14, 16-20 microns, target temp range 173K-293K). Downward sky irradiance fluxes in 8 bands (255, 295, 250-400, 450, 650, 880, 950, 190-1100 nm), and side-pointing photodetectors (880 nm and 27.5 deg. above the deck). Upward pointing CCD sensor with a +/- 60 degrees FOV around zenith.	Characterization of near-surface optical opacity and angular scattering properties of atmospheric aerosols (special emphasis on atmospheric dust size and morphology), as well as thermal response of atmosphere, radiative and convective forcing of surface and atmosphere, surface pressure cycle, water cycle and wind speed and direction
RIMFAX (Ground Penetrating Radar, mounted on back of rover)	Gated Frequency Modulated Continuous Wave Radar (150 MHz – 1200 MHz frequency range)	Subsurface radar profiles measured every 10 cm along rover track, with vertical resolution of <30 cm and penetration depths of more than 10 meters depending on materials
Returned Sample Science	Time, rover location and orientation, site information, sample drill location, other parameters associated with drilling, final sample cache location, tracking information including sample collection plans and uplinked sequences (e.g. documentation of why this target was drilled).	Observations that provide context for sample collection, including before and after images, other data that document the drill target and cache location, including remote sensing data

3 Planetary Data System Archive Overview

The NASA Planetary Data System consists of a set of Discipline Nodes, each one specializing in a subset of planetary science such as atmospheres, geosciences, and planetary rings. The PDS operates on the principle that planetary science data are best archived by experts in each field of study. For this reason data from the various Perseverance experiments are delivered to the PDS nodes according to their area of expertise. Table 2 shows the nodes that archive Perseverance data.

PDS archives include data at various processing levels from raw to highly derived. Table 3 defines the processing level terms used by PDS. Like many other NASA planetary missions, Mars 2020 uses other terms for processing levels, in particular Experiment Data Record (EDR) and Reduced Data Record (RDR). These terms occur frequently in Mars 2020 archive documentation. “EDR” is equivalent to the PDS Raw processing level. “RDR” is a catchall category that refers to any level of processing beyond the EDR. Specific types of RDR data may be given other names, such as CDR for Calibrated Data Record or DDR for Derived Data Record.

Table 2. PDS Nodes Archiving Perseverance Data

Investigation	PDS Node	
Engineering Cameras	CIS	Cartography and Imaging Sciences Node, U.S. Geological Survey, Flagstaff, Arizona, and Jet Propulsion Laboratory, Pasadena, California
Helicopter Cameras		
Mastcam-Z		
MEDA	ATM	Atmospheres Node, New Mexico State University, Las Cruces, New Mexico
MOXIE		
PIXL	GEO	Geosciences Node, Washington University, St. Louis, Missouri
Returned Sample Science		
RIMFAX		
SHERLOC		
SuperCam		
SPICE	NAIF	Navigation and Ancillary Information Facility, Jet Propulsion Laboratory, Pasadena, California

Table 3. PDS Processing Levels for Science Data

PDS processing level	Description
Telemetry	An encoded byte stream used to transfer data from one or more instruments to temporary storage where the raw instrument data will be extracted. PDS does not archive telemetry data.
Raw	Original data from an instrument. If compression, reformatting, packetization, or other translation has been applied to facilitate data transmission or storage, those processes will be reversed so that the archived data are in a PDS approved archive format. Often call EDRs (Experimental Data Records).
Partially Processed	Data that have been processed beyond the raw stage but which have not yet reached calibrated status. These and more highly processed products are often called RDRs (Reduced Data Records).
Calibrated	Data converted to physical units, which makes values independent of the instrument.
Derived	Results that have been distilled from one or more calibrated data products (for example, maps, gravity or magnetic fields, or ring particle size distributions). Supplementary data, such as calibration tables or tables of viewing geometry, used to interpret observational data should also be classified as 'derived' data if not easily matched to one of the other three categories.

4 Understanding the PDS4 Archive

4.1 Products, Collections, and Bundles

PDS develops standards for stable, accessible, well-documented science archives, and specifies the methods by which the standards are implemented. The current standard for PDS archives is PDS4. This standard organizes science data and documentation into products, collections, and bundles. Readers unfamiliar with the PDS4 standard are referred to the PDS Concepts Document [11] for a detailed explanation. What follows is a brief overview.

The most basic unit is the product. A data product typically consists of a single file containing data and a PDS label containing metadata that describe the data. Besides data products, there are other types of products such as document products and browse products.

A collection is a set of one or more basic products that are typically all of the same type, such as a collection of raw data from a single instrument. A bundle is a set of one or more collections that are likely to be of different types, such as a bundle containing the raw data collection, calibrated data collection, and document collection for a single instrument. In Mars 2020 archives there is typically one bundle for each science instrument.

In a PDS4 archive every product, collection, and bundle has a Logical Identifier (LID) that is unique throughout PDS. All PDS LIDs begin with “urn:nasa:pds:”.

Each Mars 2020 bundle LID is formed by appending a name for the bundle, such as “**urn:nasa:pds:mars2020_sherloc**”. The LID for a collection within the bundle is formed by appending a collection name, such as “**urn:nasa:pds:mars2020_sherloc:data_processed**”. Finally, a product LID is formed by appending a product name, which is usually the name of the data file, such as “**urn:nasa:pds:mars2020_sherloc:data_processed:ss__0004_0667298185_056rcc__0010052srlc10002w0__cgzj01**”.

Table 4 lists the Mars 2020 archive products, collections, and bundles, the PDS4 data type of the products in each bundle, and the parties responsible for preparing and archiving the products.

Table 4. Mars 2020 Products, Collections, and Bundles

Product Name	PDS Processing Level (raw, pp*, calibrated, derived)	PDS4 bundle:collection, assuming prefix urn:nasa:pds:	Product Description	PDS4 Data Type (e.g. Array_2D_Image, Array_3D_Image, Table_Character, Table_Delimited, Table_Binary)	Data Producer	PDS Curator (GEO, CIS, ATM)
Mission Bundle						
Mars 2020 Overview	n/a	mars2020_mission:document	Overview of Mars 2020 PDS archives	Document	GEO	GEO
Camera SIS	n/a	mars2020_mission:document_camera	Description of contents and format of raw and derived products from Mastcam-Z, Navcam, Hazcam, CacheCam, EDLCam, Helicopter cameras, SuperCam RMI, PIXL MCC, SHERLOC WATSON and ACI, and MEDA Skycam.	Document	IDS	GEO,CIS,ATM
Camera Bundle SIS	n/a	mars2020_mission:document_camera	Description of bundle organization of mars2020_ecam, mars2020_mastcamz, and mars2020_heli bundles	Document	IDS	GEO,CIS,ATM
Camera calibration information	n/a	mars2020_mission:calibration_camera	Calibration information that applies to all Mars 2020 cameras	Document	IDS	GEO
Velocity templates	n/a	mars2020_mission:miscellaneous	Templates for transfer of metadata from internal ODL labels to PDS archive labels	Document	IDS	GEO
Navcam and Hazcam Bundles						
Navcam EDRs	raw	mars2020_navcam_ops_raw:data	Raw raster images including thumbnails, subframes, downsampled images, and full-frame images	Array_3D_Image	IDS	CIS
Navcam FDR/RDRs	pp, cal, derived	mars2020_navcam_ops_calibrated:data	Images corrected for flat field, exposure time, geometrically corrected, color corrected	Array_3D_Image	IDS	CIS

Product Name	PDS Processing Level (raw, pp*, calibrated, derived)	PDS4 bundle:collection, assuming prefix urn:nasa:pds:	Product Description	PDS4 Data Type (e.g. Array_2D_Image, Array_3D_Image, Table_Character, Table_Delimited, Table_Binary)	Data Producer	PDS Curator (GEO, CIS, ATM)
Navcam stereo RDRs	pp, cal, derived	mars2020_navcam_ops_stereo:data	Derived stereo products, including disparity maps, XYZ images, range maps, surface roughness, slope maps.	Array_3D_Image	IDS	CIS
Navcam Mesh RDRs	derived	mars2020_navcam_ops_mesh:data	3D Terrain meshes in OBJ format	Table_Delimited	IDS	CIS
Navcam Mosaic RDRs	derived	mars2020_navcam_ops_mosaic:data	Mosaics and associated ancillary files	Array_3D_Image	IDS	CIS
Hazcam EDRs	raw	mars2020_hazcam_ops_raw:data	Raw raster images including thumbnails, subframes, downsampled images, and full-frame images	Array_3D_Image	IDS	CIS
Hazcam FDR/RDRs	pp, cal, derived	mars2020_hazcam_ops_calibrated:data	Images corrected for flat field, exposure time, geometrically corrected.	Array_3D_Image	IDS	CIS
Hazcam stereo RDRs	pp, cal, derived	mars2020_hazcam_ops_stereo:data	Derived stereo products, including disparity maps, XYZ images, range maps, surface roughness, slope maps.	Array_3D_Image	IDS	CIS
Hazcam Mesh RDRs	derived	mars2020_hazcam_ops_mesh:data	3D Terrain meshes in OBJ format	Table_Delimited	IDS	CIS
Hazcam Mosaic RDRs	derived	mars2020_hazcam_ops_mosaic:data	Mosaics and associated ancillary files	Array_3D_Image	IDS	CIS
CacheCam Bundles						
CacheCam EDRs	raw	mars2020_cachecam_ops_raw:data	Raw raster images including thumbnails, subframes, downsampled images, and full-frame images	Array_3D_Image	IDS	CIS
CacheCam FDR/RDRs	pp, cal, derived	mars2020_cachecam_ops_calibrated:data	Images corrected for flat field, exposure time, geometrically corrected, color corrected.	Array_3D_Image	IDS	CIS

Product Name	PDS Processing Level (raw, pp*, calibrated, derived)	PDS4 bundle:collection, assuming prefix urn:nasa:pds:	Product Description	PDS4 Data Type (e.g. Array_2D_Image, Array_3D_Image, Table_Character, Table_Delimited, Table_Binary)	Data Producer	PDS Curator (GEO, CIS, ATM)
Entry, Descent, and Landing Cameras Bundles						
LVS EDRs	raw	mars2020_edlcam_ops_raw:data	Raw raster images including thumbnails, subframes, downsampled images, and full-frame images	Array_3D_Image	IDS	CIS
EDLCam PUC EDRs	raw	mars2020_edlcam_ops_raw:data	Raw raster images including thumbnails, subframes, downsampled images, and full-frame images	Array_3D_Image	IDS	CIS
EDLCam RUC EDRs	raw	mars2020_edlcam_ops_raw:data	Raw raster images including thumbnails, subframes, downsampled images, and full-frame images	Array_3D_Image	IDS	CIS
EDLCam DDC EDRs	raw	mars2020_edlcam_ops_raw:data	Raw raster images including thumbnails, subframes, downsampled images, and full-frame images	Array_3D_Image	IDS	CIS
EDLCam RDC EDRs	raw	mars2020_edlcam_ops_raw:data	Raw raster images including thumbnails, subframes, downsampled images, and full-frame images	Array_3D_Image	IDS	CIS
LVS RDRs	pp, cal, derived	mars2020_edlcam_ops_calibrated:data	Images corrected for flat field, exposure time, geometrically corrected, color corrected.	Array_3D_Image	IDS	CIS
EDLCam PUC RDRs	pp, cal, derived	mars2020_edlcam_ops_calibrated:data	Images corrected for flat field, exposure time, geometrically corrected, color corrected.	Array_3D_Image	IDS	CIS
EDLCam RUC RDRs	pp, cal, derived	mars2020_edlcam_ops_calibrated:data	Images corrected for flat field, exposure time, geometrically corrected, color corrected.	Array_3D_Image	IDS	CIS

Product Name	PDS Processing Level (raw, pp*, calibrated, derived)	PDS4 bundle:collection, assuming prefix urn:nasa:pds:	Product Description	PDS4 Data Type (e.g. Array_2D_Image, Array_3D_Image, Table_Character, Table_Delimited, Table_Binary)	Data Producer	PDS Curator (GEO, CIS, ATM)
EDLCam DDC RDRs	pp, cal, derived	mars2020_edlcam_ops_calibrated:data	Images corrected for flat field, exposure time, geometrically corrected, color corrected.	Array_3D_Image	IDS	CIS
EDLCam RDC RDRs	pp, cal, derived	mars2020_edlcam_ops_calibrated:data	Images corrected for flat field, exposure time, geometrically corrected, color corrected.	Array_3D_Image	IDS	CIS
EDLCam Video Single Frame EDRs	derived	mars2020_edlcam_ops_raw:data	Still frame extracted from video file every nth frame	Array_3D_Image	IDS	CIS
EDLCam Video EDRs	raw	mars2020_edlcam_ops_video:data	MPEG video file	Encoded_Binary	IDS	CIS
EDLCam audio	raw	mars2020_edlcam_ops_audio:data	WAV audio file	Table_Binary	IDS	CIS
EDLCam Video EDRs	raw	m2020_edlcam_raw:document_ video	MPEG video file	Encoded_Binary	ECAM	CIS
EDLCam audio	raw	m2020_ecam_raw:data_audio	WAV audio file, both 1-second snippets and concatenated recordings	Table_Binary	ECAM	CIS
Helicopter Bundles						
Helicopter EDRs	raw	mars2020_helicam:data	Raw raster images including thumbnails, subframes, downsampled images, and full-frame images	Array_3D_Image	IDS	CIS
Helicopter bundle SIS	document	mars2020_mission:document_camera	Description of mars2020_helicopter bundle organization	Document	IDS	CIS

Product Name	PDS Processing Level (raw, pp*, calibrated, derived)	PDS4 bundle:collection, assuming prefix urn:nasa:pds:	Product Description	PDS4 Data Type (e.g. Array_2D_Image, Array_3D_Image, Table_Character, Table_Delimited, Table_Binary)	Data Producer	PDS Curator (GEO, CIS, ATM)
Rover Bundle						
Rover PLACES	derived	mars2020_rover_places:browse_maps, mars2020_rover_places:data_ancillary, mars2020_rover_places:data_localizations, mars2020_rover_places:datamaps, mars2020_rover_places:data_mechanisms, mars2020_rover_places:data_orbital, mars2020_rover_places:document	CSV tables with rover localization data, and associated base map	Table_Deliimited	IDS	CIS
Target database	derived	mars2020_rover_target [in preparation]	CSV table with target database	Table_Deliimited	IDS	CIS
RTT / Science Intent database	derived	mars2020_rover_science_intent [in preparation]	CSV table with round-trip tracking (RTT) and science intent	Table_Deliimited	IDS	CIS
Mastcam-Z Bundles						
Mastcam-Z EDR	raw	mars2020_mastcamz_ops_raw:data	Companded (8 bit) raw images (including thumbnails and images from video sequences)	Array_3D_Image	IDS	CIS
Mastcam-Z EDR	pp	mars2020_mastcamz_ops_raw:data	Raw raster images including thumbnails, subframes, downsampled images, and full-frame images	Array_3D_Image	IDS	CIS
Mastcam-Z RDR	calibrated	mars2020_mastcamz_sci_calibrated:data	CCD-corrected and radiance-calibrated RDRs	Array_3D_Image	ASU	CIS
Mastcam-Z RDR	calibrated	mars2020_mastcamz_sci_calibrated:data	Calibrated Radiance Factor (I/F) RDRs	Array_3D_Image	ASU	CIS
Mastcam-Z RDR	derived	mars2020_mastcamz_sci_calibrated:data	Tables of derived atmospheric opacity (tau) versus time	Table_Delimited	Texas A&M	CIS
Mastcam-Z image TDR/FDR/RDRs	pp, cal, derived	mars2020_mastcamz_ops_callibrated:data	Images corrected for flat field, exposure time, geometrically corrected, color corrected.	Array_3D_Image	IDS	CIS

Product Name	PDS Processing Level (raw, pp*, calibrated, derived)	PDS4 bundle:collection, assuming prefix urn:nasa:pds:	Product Description	PDS4 Data Type (e.g. Array_2D_Image, Array_3D_Image, Table_Character, Table_Delimited, Table_Binary)	Data Producer	PDS Curator (GEO, CIS, ATM)
Mastcam-Z stereo RDRs	pp, cal, derived	mars2020_mastcamz_ops_stereo:data	Derived stereo products, including disparity maps, XYZ images, range maps, surface roughness, slope maps.	Array_3D_Image	IDS	CIS
Mastcam-Z Mesh RDRs	derived	mars2020_mastcamz_ops_mesh:data	3D Terrain meshes in OBJ format	Table_Delimited	IDS	CIS
Mastcam-Z Mosaic RDRs	derived	mars2020_mastcamz_ops_mosaic:data	Mosaics and associated ancillary files	Array_3D_Image	IDS	CIS
Mastcam-Z Video RDRs	raw	mars2020_mastcamz_sci:data	Image frames	Array_3D_Image	Mastcam-Z	CIS
Mastcam-Z Derived Product SIS	document	mars2020_mastcamz_sci:document	Description of derived Mastcam-Z products	Document	Mastcam-Z	CIS
Mastcam-Z Image Inventory	document	mars2020_mastcamz_sci:document	Mastcam-Z image inventory	Document	Mastcam-Z	CIS
Mastcam-Z Preflight Calibration	document	mars2020_mastcamz_sci:document	Preflight calibration documentation	Document	Mastcam-Z	CIS
Mastcam-Z Radiometric Calibration	document	mars2020_mastcamz_sci:document	Radiometric calibration documentation	Document	Mastcam-Z	CIS
MEDA Bundle						
MEDA EDR	raw	mars2020_meda:data_raw_env	Raw telemetry data for all sensors except images	Table_Delimited	MEDA	ATM
MEDA EDR	raw	mars2020_meda:data_skycam	Raw Skycam images	Array_2D_Image	MEDA	ATM

Product Name	PDS Processing Level (raw, pp*, calibrated, derived)	PDS4 bundle:collection, assuming prefix urn:nasa:pds:	Product Description	PDS4 Data Type (e.g. Array_2D_Image, Array_3D_Image, Table_Character, Table_Delimited, Table_Binary)	Data Producer	PDS Curator (GEO, CIS, ATM)
MEDA RDR	pp	mars2020_meda:data_partially_processed_env	Raw telemetry data converted to electrical units	Table Delimited	MEDA	ATM
MEDA RDR	calibrated	mars2020_meda:data_calibrated_env	Calibrated time series per detector of pressure (mbar), air temperature (K), downward sky radiation (2 bands, K), upward IR radiation (3 bands, K), downward solar radiation (7 bands + 1 panchromatic, W/m2), diffuse radiation, humidity (%RH), horizontal and vertical wind speed (m/s) and direction. In addition, time series of ancillary data needed for the correct interpretation of the sensors data	Table_Delimited	MEDA	ATM
MEDA RDR	calibrated	mars2020_meda:data_skycam	Calibrated Skycam images	Array_2D_Image	MEDA	ATM
MEDA RDR	derived	mars2020_meda:data_derived_env	Modeled time series of pressure (mbar), air temperature (K), downward sky radiation (2 bands, K), upward IR radiation (3 bands, K), downward solar radiation (7 bands + 1 panchromatic, W/m2), diffuse radiation, local relative humidity (%RH), volume mixing ratio (ppm), horizontal and vertical wind speed (m/s) and direction.	Table_Delimited	MEDA	ATM
MEDA EDR SIS	document	mars2020_meda:document	Description of EDR contents and format	Document	MEDA	ATM
MEDA RDR SIS	document	mars2020_meda:document	Description of RDR contents and format	Document	MEDA	ATM
MEDA Bundle SIS	document	mars2020_meda:document	Description of mars2020_meda bundle organization	Document	MEDA	ATM

Product Name	PDS Processing Level (raw, pp*, calibrated, derived)	PDS4 bundle:collection, assuming prefix urn:nasa:pds:	Product Description	PDS4 Data Type (e.g. Array_2D_Image, Array_3D_Image, Table_Character, Table_Delimited, Table_Binary)	Data Producer	PDS Curator (GEO, CIS, ATM)
MOXIE Bundle						
MOXIE EDR	raw	mars2020_moxie:data_raw	Raw telemetry: time series of measured and commanded quantities recorded once per second. Quantities are in units of Digital Numbers (DN). There are two types of telemetry record, standard and extended. Standard telemetry records are always produced. Extended telemetry records are only produced if there is a fault or on command. Standard telemetry includes 123 items, including: O2, CO and CO2 sensor raw data, 20 x temperature, 5 x pressure, 1 x scroll compressor RPM, 2 x SOXE voltage and current. The detailed format is described in the SIS.	Table_Delimited	MOXIE	ATM
MOXIE RDR	calibrated	mars2020_moxie:data_calibrated	Calibrated telemetry: time series of measured and commanded quantities recorded once per second. Quantities are in units of Calibrated Units (CUs).	Table_Delimited	MOXIE	ATM
MOXIE RDR	derived	mars2020_moxie:data_derived	In general, there are two types of derived products: time series of derived quantities such as flow rates, oxygen production rates, oxygen purity, or figures of merit for the SOXE; and scalar quantities derived from processing of the time series data, such as the total amount of oxygen produced or energy utilized.	Table_Delimited	MOXIE	ATM
MOXIE SIS	document	mars2020_moxie:document	Data product Software Interface Specification (SIS)	Document	MOXIE	ATM
MOXIE Bundle SIS	document	mars2020_moxie:document	Description of mars2020_moxie bundle organization	Document	MOXIE	ATM

Product Name	PDS Processing Level (raw, pp*, calibrated, derived)	PDS4 bundle:collection, assuming prefix urn:nasa:pds:	Product Description	PDS4 Data Type (e.g. Array_2D_Image, Array_3D_Image, Table_Character, Table_Delimited, Table_Binary)	Data Producer	PDS Curator (GEO, CIS, ATM)
MOXIE Instrument Paper	document	mars2020_moxie:document	Pre-mission instrument paper	Document	MOXIE	ATM
PIXL Bundle						
PIXL HK FRAME EDR	raw	mars2020_pixl:data_raw_ancillary	Engineering data at the time of each X-ray measurement	Table_Delimited	IDS	GEO
PIXL REMARK EDR	raw	mars2020_pixl:data_raw_ancillary	Brief ASCII character string	Table_Delimited	IDS	GEO
PIXL SCAN LOG EDR	raw	mars2020_pixl:data_raw_ancillary	Scan Log that gives the actual (drift-corrected) hexapod coordinates for each X-ray measurement	Table_Binary	IDS	GEO
PIXL HISTOGRAM NORMAL A EDR	raw	mars2020_pixl:data_raw_spectroscopy	Regular histogram at nominal dwell time from X-ray detector A	Table_Delimited	IDS	GEO
PIXL HISTOGRAM NORMAL B EDR	raw	mars2020_pixl:data_raw_spectroscopy	Regular histogram at nominal dwell time from X-ray detector B	Table_Delimited	IDS	GEO
PIXL HISTOGRAM DWELL A EDR	raw	mars2020_pixl:data_raw_spectroscopy	Regular histogram at longer dwell time from X-ray detector A	Table_Delimited	IDS	GEO
PIXL HISTOGRAM DWELL B EDR	raw	mars2020_pixl:data_raw_spectroscopy	Regular histogram at longer dwell time from X-ray detector B	Table_Delimited	IDS	GEO
PIXL PSEUDOINTENSITY NORMAL EDR	raw	mars2020_pixl:data_raw_spectroscopy	Pseudointensity Data for each nominal-dwell X-ray histogram calculated onboard (32 channels of summed spectrum data)	Table_Delimited	IDS	GEO

Product Name	PDS Processing Level (raw, pp*, calibrated, derived)	PDS4 bundle:collection, assuming prefix urn:nasa:pds:	Product Description	PDS4 Data Type (e.g. Array_2D_Image, Array_3D_Image, Table_Character, Table_Delimited, Table_Binary)	Data Producer	PDS Curator (GEO, CIS, ATM)
PIXL PSEUDOINTENSITY DWELL EDR	raw	mars2020_pixl:data_raw_spectroscopy	Pseudointensity Data for each longer-dwell X-ray histogram calculated onboard (32 channels of summed spectrum data)	Table_Delimited	IDS	GEO
PIXL HISTOGRAM MAX VALUE A EDR	raw	mars2020_pixl:data_raw_spectroscopy	Max Value Histogram from Detector A (see definition under RDRs below)	Table_Delimited	IDS	GEO
PIXL HISTOGRAM MAX VALUE B EDR	raw	mars2020_pixl:data_raw_spectroscopy	Max Value Histogram from Detector B	Table_Delimited	IDS	GEO
PIXL HISTOGRAM BULK SUM A EDR	raw	mars2020_pixl:data_raw_spectroscopy	Bulk Sum Histogram from Detector A	Table_Delimited	IDS	GEO
PIXL HISTOGRAM BULK SUM B EDR	raw	mars2020_pixl:data_raw_spectroscopy	Bulk Sum Histogram from Detector B	Table_Delimited	IDS	GEO
PIXL MCC OLM TRN ESTIMATE EDR	raw	mars2020_pixl:data_raw_ancillary	Autonomous terrain relative navigation data from the MCC (used for thermal drift correction)	Table_Delimited	IDS	GEO
PIXL MCC SLI ESTIMATES EDR	raw	mars2020_pixl:data_raw_ancillary	Distance and plane solutions derived from the SLI measurements.	Table_Delimited	IDS	GEO
PIXL MCC CENTROIDS EDR	raw	mars2020_pixl:data_raw_ancillary	Centroid positions on the CCD of the spots from the SLI beams (without spatial coordinates or plane fits)	Table_Delimited	IDS	GEO
PIXL MCC CIRCLE CENTROID EDR	raw	mars2020_pixl:data_raw_ancillary	Estimated circle center and radius of an abraded patch (used to automatically locate the measurement positions)	Table_Binary	IDS	GEO

Product Name	PDS Processing Level (raw, pp*, calibrated, derived)	PDS4 bundle:collection, assuming prefix urn:nasa:pds:	Product Description	PDS4 Data Type (e.g. Array_2D_Image, Array_3D_Image, Table_Character, Table_Delimited, Table_Binary)	Data Producer	PDS Curator (GEO, CIS, ATM)
PIXL MCC ROI EDR	raw	mars2020_pixl:data_raw_ancillary	Returns an image region around each spot from an SLI beam in uncompressed format	Table_Binary	IDS	GEO
PIXL MCC JPEG IMAGE EDR	raw	mars2020_imgops:data_mcc_imgops mars2020_pixl:data_imaging (secondary members**)	JPEG compressed context image converted to Array_2D_Image	Array_2D_Image	IDS	GEO
PIXL MCC RAW BIT-MAP IMAGE EDR	raw	mars2020_imgops:data_mcc_imgops mars2020_pixl:data_imaging (secondary members**)	Uncompressed MCC images (raw bitmaps)	Array_2D_Image	IDS	GEO
PIXL LOCALIZED FULL SPECTRA RDR	calibrated	mars2020_pixl:data_processed	XRF spectrum for each measured location on the target with energy calibration, spatial location, and pixel location in context image	Table_Delimited	PIXL	GEO
PIXL MCC CONTEXT IMAGE RDR	pp	mars2020_imgops:data_mcc_imgops mars2020_pixl: data_ processed (secondary members**)	MCC Image context image (black-and-white image of target rock) with geometric and radiometric corrections applied	Array_2D_Image	IDS	GEO
PIXL MCC CONTEXT IMAGE WITH MARKUP RDR	calibrated	mars2020_pixl:data_ processed	Markup on MCC context image showing calculated X-ray measurement locations	Array_2D_Image	PIXL	GEO
PIXL DRIFT CORRECTED X_RAY BEAM LOCATIONS RDR	calibrated	mars2020_pixl:data_processed	Location of each X-ray measurement in spatial coordinates and pixel location in context image, corrected for thermal drift of robotic arm position or other unexpected motion	Table_Delimited	PIXL	GEO

Product Name	PDS Processing Level (raw, pp*, calibrated, derived)	PDS4 bundle:collection, assuming prefix urn:nasa:pds:	Product Description	PDS4 Data Type (e.g. Array_2D_Image, Array_3D_Image, Table_Character, Table_Delimited, Table_Binary)	Data Producer	PDS Curator (GEO, CIS, ATM)
PIXL BULK SUMMED SPECTRUM RDR	calibrated	mars2020_pixl:data_processed	Bulk Sum Spectrum (one for each target, all PIXL point spectra for this target summed) with energy calibration	Table_Delimited	PIXL	GEO
PIXL MAX VALUE SPECTRUM RDR	calibrated	mars2020_pixl:data_processed	Max Value Spectrum (maximum measured value for each channel in the set of spectra for this target) with energy calibration	Table_Delimited	PIXL	GEO
PIXL BULK QUANTITATIVE MEASUREMENT RDR	derived	mars2020_pixl:data_processed	Quantification (element weight percents) for bulk sum spectrum	Table_Delimited	PIXL	GEO
PIXL PSEUDOINTENSITY RDR	calibrated	mars2020_pixl:data_processed	Pseudointensity values (as computed onboard) with measurement locations in spatial coordinates and pixel locations in context image	Table_Delimited	PIXL	GEO
PIXL ROCK COMPONENT SUMS RDR	derived	mars2020_pixl:data_processed	Rock Component Sum (if components can be identified and associated in spectrum maps), including summed spectrum, net intensities, and quantification	Table_Delimited	PIXL	GEO
PIXL CALIBRATION RDR	n/a	mars2020_pixl:document	Elemental and geometric calibration package	Document	PIXL	GEO
PIXL EDR SIS	n/a	mars2020_pixl:document	Description of EDR contents and format	Document	IDS	GEO
PIXL RDR SIS	n/a	mars2020_pixl:document	Description of RDR contents and format	Document	PIXL	GEO
PIXL Bundle SIS	n/a	mars2020_pixl:document	Description of mars2020_pixl bundle organization	Document	PIXL	GEO

Product Name	PDS Processing Level (raw, pp*, calibrated, derived)	PDS4 bundle:collection, assuming prefix urn:nasa:pds:	Product Description	PDS4 Data Type (e.g. Array_2D_Image, Array_3D_Image, Table_Character, Table_Delimited, Table_Binary)	Data Producer	PDS Curator (GEO, CIS, ATM)
PIXL User Guide	n/a	mars2020_pixl:document	Overview of PIXL bundle	Document	PIXL	GEO
RIMFAX Bundle						
RIMFAX	raw	mars2020_rimfax:data_raw	Depacketized, time sequenced raw science data and metadata. Frequency domain.	Table_Binary	IDS	GEO
RIMFAX	raw	mars2020_rimfax:data_hk	Depacketized, time sequenced housekeeping data	Table_Binary	IDS	GEO
RIMFAX	calibrated	mars2020_rimfax:data_calibrated	Depacketized, time sequenced and sounding-by-sounding metadata, with location and topography data updated to best knowledge.	Table_Delimited	RIMFAX/PLACES	GEO
RIMFAX	browse	mars2020_rimfax:browse_radargram	Browse image for the derived time-domain radar data with the surface vertically shifted to incorporate topography	Product_Browse (PNG)	RIMFAX	GEO
RIMFAX EDR SIS	n/a	mars2020_rimfax:document	Description of EDR contents and format	Document	RIMFAX	GEO
RIMFAX RDR SIS	n/a	mars2020_rimfax:document	Description of RDR contents and format	Document	RIMFAX	GEO
RIMFAX Bundle SIS	n/a	mars2020_rimfax:document	Description of mars2020_rimfax bundle organization	Document	RIMFAX	GEO
SHERLOC Bundle						
SHERLOC Spectroscopy EDR	raw	mars2020_sherloc:data_raw	Raw Deep Ultra-violet (DUV) Resonance Raman and Fluorescence Spectroscopy data	Table_Delimited	IDS	GEO

Product Name	PDS Processing Level (raw, pp*, calibrated, derived)	PDS4 bundle:collection, assuming prefix urn:nasa:pds:	Product Description	PDS4 Data Type (e.g. Array_2D_Image, Array_3D_Image, Table_Character, Table_Delimited, Table_Binary)	Data Producer	PDS Curator (GEO, CIS, ATM)
SHERLOC ACI EDR	raw	mars2020_imgops:data_aci_imgops mars2020_sherloc:data_aci (secondary members**)	Raw Autofocus Context Imager (ACI) Images	Array_2D_Image / Array_3D_Image	IDS	GEO
SHERLOC WATSON EDR	raw	mars2020_imgops:data_watson_imgops mars2020_sherloc:data_watson (secondary members**)	Raw Wide Angle Topographic Sensor for Operations and eNgineering (WATSON) Images	Array_2D_Image / Array_3D_Image	IDS	GEO
SHERLOC ACI RDR	pp / calibrated / derived	mars2020_imgops:data_aci_imgops mars2020_sherloc:data_aci (secondary members**)	Corrected/Calibrated ACI Images	Array_2D_Image / Array_3D_Image	IDS	GEO
SHERLOC WATSON RDR	pp / calibrated / derived	mars2020_imgops:data_watson_imgops mars2020_sherloc:data_watson (secondary members**)	Corrected/calibrated WATSON Images	Array_2D_Image / Array_3D_Image	IDS	GEO
SHERLOC Spectroscopy RDR	pp / calibrated	mars2020_sherloc:data_intermediate	Deep Ultra-violet (DUV) Resonance Raman and Fluorescence Spectroscopy data with intermediate calibration applied	Table_Delimited	SHERLOC	GEO
SHERLOC Spectroscopy RDR	calibrated / derived	mars2020_sherloc:data_processed	Corrected/calibrated Deep Ultra-violet (DUV) Resonance Raman and Fluorescence Spectroscopy data	Table_Delimited	SHERLOC	GEO
SHERLOC EDR SIS	n/a	mars2020_sherloc:document	Description of EDR contents and format	Document	SHERLOC	GEO
SHERLOC RDR SIS	n/a	mars2020_sherloc:document	Description of RDR contents and format	Document	SHERLOC	GEO

Product Name	PDS Processing Level (raw, pp*, calibrated, derived)	PDS4 bundle:collection, assuming prefix urn:nasa:pds:	Product Description	PDS4 Data Type (e.g. Array_2D_Image, Array_3D_Image, Table_Character, Table_Delimited, Table_Binary)	Data Producer	PDS Curator (GEO, CIS, ATM)
SHERLOC Bundle SIS	n/a	mars2020_sherloc:document	Description of mars2020_sherloc bundle organization	Document	SHERLOC	GEO
SHERLOC User Guide	n/a	mars2020_sherloc:document	Overview of SHERLOC bundle	Document	SHERLOC	GEO
SuperCam Bundle						
SuperCam LIBS EDR	raw	mars2020_supercam:data_raw_spectra	Raw LIBS spectra	Table_Binary	IDS	GEO
SuperCam VIS EDR	raw	mars2020_supercam:data_raw_spectra	Raw VISIR spectra	Table_Binary	IDS	GEO
SuperCam IR EDR	raw	mars2020_supercam:data_raw_spectra	Raw IR spectra	Table_Binary	IDS	GEO
SuperCam Raman EDR	raw	mars2020_supercam:data_raw_spectra	Raw Raman spectra	Table_Binary	IDS	GEO
SuperCam TRLS EDR	raw	mars2020_supercam:data_raw_spectra	Raw Time-resolved luminescence spectra	Table_Binary	IDS	GEO
SuperCam RMI EDR	raw	mars2020_imgops:data_rmi_imgops mars2020_supercam:data_raw_rmi (secondary members**)	RMI raw images	Array_2D_Image	IDS	GEO
SuperCam MIC EDR	raw	mars2020_supercam:data_raw_audio	Raw acoustic recording	Table_Binary	IDS	GEO
SuperCam LIBS RDR	calibrated	mars2020_supercam:data_calibrated_spectra	LIBS spectra calibrated with wavelength calibration	Table_Binary	SuperCam	GEO
SuperCam VIS RDR	calibrated	mars2020_supercam:data_calibrated_spectra	VIS spectra calibrated	Table_Binary	SuperCam	GEO
SuperCam IR RDR	calibrated	mars2020_supercam:data_calibrated_spectra	IR spectra calibrated	Table_Binary	SuperCam	GEO

Product Name	PDS Processing Level (raw, pp*, calibrated, derived)	PDS4 bundle:collection, assuming prefix urn:nasa:pds:	Product Description	PDS4 Data Type (e.g. Array_2D_Image, Array_3D_Image, Table_Character, Table_Delimited, Table_Binary)	Data Producer	PDS Curator (GEO, CIS, ATM)
SuperCam Raman RDR	calibrated	mars2020_supercam:data_calibrated_spectra	Raman spectra calibrated with wavelength calibration	Table_Binary	SuperCam	GEO
SuperCam TRLS RDR	calibrated	mars2020_supercam:data_calibrated_spectra	TRLS spectra calibrated with wavelength calibration	Table_Binary	SuperCam	GEO
SuperCam RMI RDR	calibrated	mars2020_supercam:data_radcal_rmi	RMI Partially radiometrically corrected images	Array_2D_Image	SuperCam	GEO
SuperCam MIC RDR	calibrated	mars2020_supercam:data_calibrated_audio	MIC time series calibrated in Pascal	Table_Binary	SuperCam	GEO
SuperCam LIBS RDR	derived	mars2020_supercam:data_derived_spectra	LIBS element abundances	Table_Delimited	SuperCam	GEO
SuperCam VIS RDR	derived	mars2020_supercam:data_derived_spectra	Ratio of VIS data to the SCCT_White cal target taken under similar conditions	Table_Delimited	SuperCam	GEO
SuperCam IR RDR	derived	mars2020_supercam:data_derived_spectra	Ratio of IR data to the SCCT_White cal target taken under similar conditions	Table_Delimited	SuperCam	GEO
SuperCam Raman RDR	derived	mars2020_supercam:data_derived_spectra	Table of features with columns for likely mineral identifications and possible mineral identifications	Table_Delimited	SuperCam	GEO
SuperCam TRLS RDR	derived	mars2020_supercam:data_derived_spectra	Table of features with columns for likely mineral identifications and possible mineral identifications	Table_Delimited	SuperCam	GEO
SuperCam RMI Mosaic RDR	derived	mars2020_supercam:data_special_rmi	RMI mosaics from individual RMI RDR products, position of observations noted	Array_2D_Image	SuperCam	GEO

Product Name	PDS Processing Level (raw, pp*, calibrated, derived)	PDS4 bundle:collection, assuming prefix urn:nasa:pds:	Product Description	PDS4 Data Type (e.g. Array_2D_Image, Array_3D_Image, Table_Character, Table_Delimited, Table_Binary)	Data Producer	PDS Curator (GEO, CIS, ATM)
SuperCam RMI Mastcam Mosaic RDR	derived	mars2020_supercam:data_special_rmi	Mastcam images with the outlines of the RMI image overlaid	Array_2D_Image	SuperCam	GEO
SuperCam MIC RDR	calibrated	mars2020_supercam:data_calibrated_audio	MP4 audio recordings supplementary to data_calibrated_audio products (WAV files)	Encoded_Audio	SuperCam	GEO
SuperCam Master target	derived	mars2020_supercam:data_observation_log	SuperCam master spreadsheet with information about all targets.	Table_Delimited	SuperCam	GEO
SuperCam Calibration Data	derived	mars2020_supercam:calibration_supercam	SuperCam instrument calibration data	Table_Binary	SuperCam	GEO
SuperCam EDR RDR SIS	document	mars2020_supercam:document	Description of EDR and RDR contents and format	Document	IDS / SuperCam	GEO
SuperCam Bundle SIS	document	mars2020_supercam:document	Description of mars2020_supercam bundle organization	Document	SuperCam	GEO
SuperCam User Guide	document	mars2020_supercam:document	Instructions for using SuperCam data products	Document	SuperCam	GEO

Notes

* pp = “partially processed”. This processing level is for data that have undergone some processing beyond the raw product, but that are not yet calibrated.

** “Secondary members” indicates that some or all members of the collection are primary members of another collection. Every product is a primary member of exactly one collection, and is physically resident at the location of that collection. A product may be a secondary member of another collection, meaning its Logical Identifier is listed in that collection’s inventory, but it is not physically copied there.

4.2 XML Labels

The metadata for a PDS4 product is recorded in a PDS4 label using XML (eXtensible Markup Language). Typically a label has the same file name as the data file it describes but with the extension ".xml". A product may consist of more than one data object (i.e. a table or an image) in a file, and it may consist of more than one data file, but a product always has exactly one PDS4 label in a file by itself.

Some Mars 2020 data products have other kinds of labels embedded in the data files. In such a case the product's PDS4 label will include descriptions of any embedded labels.

XML is a widely used standard for storing metadata. While it is easy for software to read, it can be more difficult for humans to read. XML labels are best viewed using an XML-aware editor that can help by color-coding the XML elements and allowing the reader to open and close sections of the label. Some commonly used XML-aware editors are Notepad++, Visual Studio Code, UltraEdit, xmplify, and Oxygen. Oxygen is the editor used by many PDS personnel.

4.3 Displaying PDS4 Data Products

The PDS4 Viewer is a standalone program available from PDS that displays products with PDS4 labels. The program is built using a Python library that is also available. Users of the commercial software IDL may make use of PDS-designed IDL functions for reading PDS products.

Software hyperlinks mentioned in this section and the previous section are summarized in Appendix A.

4.4 PDS Data Dictionaries

The content of the PDS4 XML labels is rigorously controlled by PDS to ensure quality and consistency. Every element in a PDS4 label is defined in a data dictionary, either in the core PDS dictionary or one of several discipline-specific or mission-specific dictionaries. Table 5 lists the dictionaries used in Mars 2020 archives. These dictionaries are actively maintained and frequently updated, but previous versions remain available. The versions listed in the table are those in place at the time of the first Mars 2020 data release. All PDS dictionaries may be found at https://pds.nasa.gov/datastandards/dictionaries/.

Table 5. Data Dictionaries Used In Mars 2020 PDS4 Archives

Dictionary	File Name	Steward
PDS Core Dictionary	PDS4_PDS_1G00.*	PDS Engineering Node
Mars 2020 Mission Dictionary	PDS4_MARS2020_1G00_1000.*	PDS Geosciences Node
Cartography Discipline Dictionary	PDS4_CART_1G00_1950.*	PDS Cartography and Imaging Sciences Node
Display Discipline Dictionary	PDS4_DISP_1G00_1500.*	PDS Small Bodies Node
Geometry Discipline Dictionary	PDS4_GEOM_1G00_1930.*	PDS Geosciences Node
Imaging Discipline Dictionary	PDS4_IMG_1G00_1860.*	PDS Cartography and Imaging Sciences Node
Mission Information Common Discipline Dictionary	PDS4_MSN_1G00_1300.*	PDS Cartography and Imaging Sciences Node
Mission Surface Discipline Dictionary	PDS4_MSN_SURFACE_1G00_1220.*	PDS Cartography and Imaging Sciences Node
MSSS Camera Mini-header Discipline Dictionary	PDS4_MSSS_CAM_MH_1G00_1020.*	PDS Cartography and Imaging Sciences Node
Processing Information Discipline Dictionary	PDS4_PROC_1G00_1210.*	PDS Cartography and Imaging Sciences Node

Surface Imaging Discipline Dictionary	PDS4_IMG_SURFACE_1G00_1250.*	PDS Cartography and Imaging Sciences Node

4.5 Documentation

Each Mars 2020 bundle typically includes a document collection. Table 6 lists the documents usually found in a document collection. The term "SIS" used in the table is short for Software Interface Specification. These documents are listed in the order recommended for reading by someone new to the archive.

The engineering camera bundles (Navcam, Hazcam, Cachecam, EDLCam, Helicam) do not include a document collection. Instead, their documentation is grouped together in the document_camera collection of the Mission bundle.

Table 6. Contents of the Document Collection

Document Type	Contents
Release Notes	The release notes are revised with every release of Mars 2020 data. They note the types of products included in the current release, the time span covered by the release, updates to products from previous releases (if any), and any notes and errata relevant to the release.
Bundle SIS	The Bundle SIS describes the overall organization and structure of the bundle, including the directory structure, the file naming scheme, the way that product LIDs are formed, and the types and formats of products found in the bundle.
User Guide	The User Guide is typically a condensed version of the Data Product SIS intended for the end user of the data, omitting much of the material in the SIS that is not relevant for the science user. Not all bundles have a User Guide.
Data Product SIS	A detailed, in-depth description of the format and contents of products in the data collections of the bundle. Sometimes there will be separate SIS documents for raw (EDR) and reduced (RDR) products, but sometimes they are combined in one SIS. The audience for the SIS includes the end user of the data as well as the mission personnel responsible for generating the data products. Much of the detailed information is useful for mission personnel but may not be important to the end user.

5 Public Releases of Mars 2020 Data

The Mars 2020 mission releases data to PDS at regular intervals. The first two releases covered 90 sols (Mars days) each. Starting with Release 3, releases occur three times a year, avoiding holidays. The number of sols covered varies slightly in each release. The schedule in Table 7 extends through the end of the primary mission.

Table 7. Schedule for Public Releases of Mars 2020 Data to PDS

Release number	Start sol	End sol	Start date	End date	Delivered to PDS by…	Released to public on…
1	0	89	18-Feb-2021	21-May-2021	30-Jul-2021	20-Aug-2021
2	90	179	22-May-2021	21-Aug-2021	01-Nov-2021	22-Nov-2021
3	180	299	22-Aug-2021	22-Dec-2021	01-Mar-2022	22-Mar-2022
4	300	419	23-Dec-2021	25-Apr-2022	30-Jun-2022	22-Jul-2022
5	420	539	26-Apr-2022	26-Aug-2022	01-Nov-2022	21-Nov-2022

6	540	639	27-Aug-2022	07-Dec-2022	14-Feb-2023	07-Mar-2023
7	640	669	08-Dec-2022	07-Jan-2023	15-Jun-2023	06-Jul-2023

5.1 Where To Find Mars 2020 PDS Archives

As mentioned in Section 3, the various Mars 2020 bundles are archived at the PDS nodes according to their area of expertise. Each node provides public access to the data via its web site. When beginning a search for Mars 2020 data, it is not necessary to know in advance which node hosts the archive, because the main PDS web site provides a search function across all of PDS. Table 8 lists the URLs for the main PDS search function and for the specific web sites for each bundle at the various PDS nodes.

Table 8. Links to Mars 2020 PDS Archives

Bundle	URL	PDS Node
All	https://pds.nasa.gov/datasearch/data-search/	n/a
Engineering Cameras	https://pds-imaging.jpl.nasa.gov/data/mars2020/mars2020_ecam/	CIS
EDLCam Raw Audio/Video	https://pds-imaging.jpl.nasa.gov/data/mars2020/m2020_edlcam_raw/	CIS
Helicopter	https://pds-imaging.jpl.nasa.gov/data/mars2020/mars2020_helicam/	CIS
Image Ops	https://pds-imaging.jpl.nasa.gov/data/mars2020/mars2020_imgops/	CIS
Mastcam-Z	https://pds-imaging.jpl.nasa.gov/data/mars2020/mars2020_mastcamz/	CIS
MEDA	https://pds-atmospheres.nmsu.edu/PDS/data/PDS4/Mars2020/mars2020_meda	ATM
Mission	https://pds-geosciences.wustl.edu/missions/mars2020/mission.htm	GEO
MOXIE	https://pds-atmospheres.nmsu.edu/PDS/data/PDS4/Mars2020/moxie_bundle	ATM
PIXL	https://pds-geosciences.wustl.edu/missions/mars2020/pixl.htm	GEO
Returned Sample Science	https://pds-geosciences.wustl.edu/missions/mars2020/returned_sample_science.htm	GEO
RIMFAX	https://pds-geosciences.wustl.edu/missions/mars2020/rimfax.htm	GEO
Rover	https://pds-geosciences.wustl.edu/missions/mars2020/rover.htm	GEO
SHERLOC	https://pds-geosciences.wustl.edu/missions/mars2020/sherloc.htm	GEO
SPICE	https://naif.jpl.nasa.gov/pub/naif/pds/pds4/mars2020/mars2020_spice/	NAIF
SuperCam	https://pds-geosciences.wustl.edu/missions/mars2020/supercam.htm	GEO

5.2 The Perseverance Analyst's Notebook

PDS offers the Perseverance Analyst's Notebook, an online service for science users of Perseverance data. Like other PDS Analyst's Notebooks for landed missions, it provides tools for detailed searches of data products, interactive data display, and connections to mission documentation that help the user understand the data in the context of mission operations. The Notebook has many features for the experienced user of PDS data as well as abundant help for the novice user.

The Analyst's Notebook is available at https://an.rsl.wustl.edu/.

Appendix A. Software Hyperlinks

Below is a list of hyperlinks to software mentioned in this document.

Software name	Hyperlink	Purpose	Operating system
Notepad++	https://notepad-plus-plus.org/	XML-aware editor	Windows
PDS4 Viewer	http://sbndev.astro.umd.edu/wiki/PDS4_Viewer	Read and display PDS4-labeled data	Windows, Linux, macOS
PDS4 Python library	http://sbndev.astro.umd.edu/wiki/Python_PDS4_Tools	Read and display PDS4-labeled data	Windows, Linux, macOS
PDS4 IDL functions	https://pdssbn.astro.umd.edu/tools/tools_readPDS.shtml (requires IDL: https://www.l3harrisgeospatial.com/Software-Technology/IDL)	Read and display PDS4-labeled data	Windows, Linux, macOS
Oxygen	https://www.oxygenxml.com/	XML-aware editor	Windows, Linux, macOS
UltraEdit	https://www.ultraedit.com/	XML-aware editor	Windows, Linux, macOS
Visual Studio Code	https://code.visualstudio.com/	XML-aware editor	Windows, Linux, macOS
xmplify	http://xmplifyapp.com/	XML-aware editor	macOS