MARS 2020
PIXL PDS Archive User's Guide

Version 1.1

July 21, 2021

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1. Overview

This document is a quick start guide to the Mars 2020 PIXL data archive. This document is intended to give users a basic understanding of the PIXL archive, where to find relevant data products and information, and identify any caveats on data collection.

1.1. What is PIXL?

PIXL (Planetary Instrument for X-ray Lithochemistry) is a microfocus X-ray fluorescence instrument mounted to the robotic arm of the *Perseverance* rover. PIXL measures elemental chemistry at sub-millimeter scales by focusing an X-ray beam to a small spot ~ 150 um, scanning the surface with this beam, and then measuring the induced X-ray fluorescence. PIXL also contains a micro-context camera (MCC) that correlates sub-mm scale geochemistry with surface texture (~ 50 µm/pixel, FOV of 29 x 36 mm at the nominal working distance of 25.5 mm). The camera, X-ray source, and two X-ray detectors (sensitive from <1 keV to >20 keV) are mounted to a hexapod – a six-axis platform that steers the PIXL beam in three dimensions, enabling precise positioning and re-focusing at each spot within each scan, based on the DEM derived from the MCC structured illuminators. See Document [11] for a full description of the instrument.

1.2. How will PIXL operate?

PIXL will acquire high spatial resolution observations of rock and soil chemistry using micro X-ray fluorescence (XRF). Over a period of several hours, PIXL can autonomously raster-scan an area of the rock surface and acquire a hyperspectral map comprised of several thousand individual measured points. When correlated to a visual image acquired by PIXL's micro-context camera—these maps reveal the distribution and abundance variations of chemical elements making up the rock, tied accurately to the physical texture and structure of the rock, at a scale comparable to a 10X magnifying geological hand lens. A Navcam image of PIXL mounted on the robotic arm is presented in Figure 1.

Figure 1: A Navcam image of PIXL on the surface of Mars

In Figure 2, a CAD of the PIXL sensor head is presented, showing the hexapod struts and the main PIXL sensor assembly. The sensor head is mounted onto the turret with isolation struts and 6 active struts that provide x, y, and z motion. The active hexapod is driven by the needs to: scan the surface for a map, correct for any placement errors or drift errors from the robotic arm, and to focus the X-ray spot on the surface based on the distance to the target.

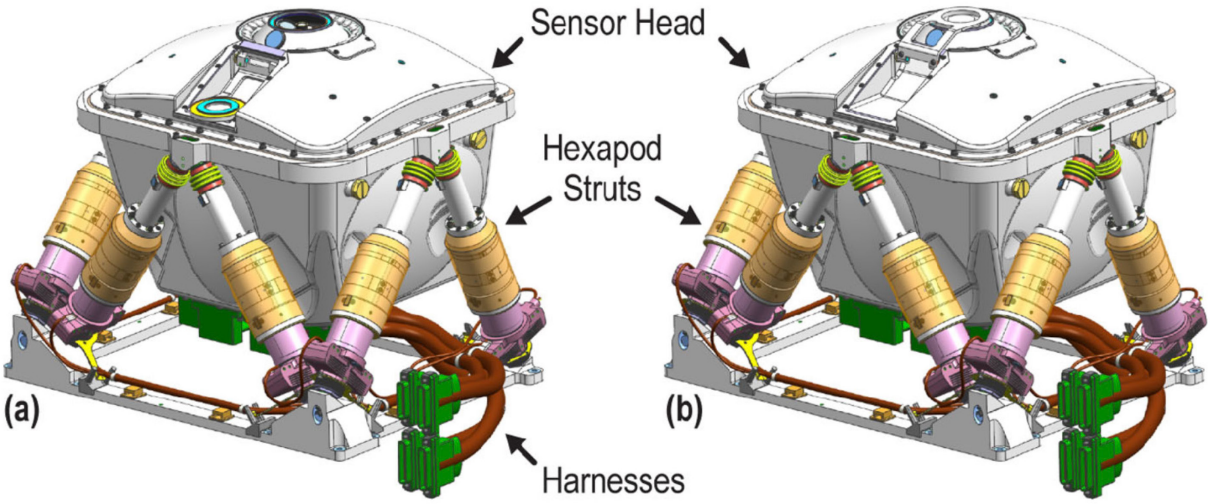


Figure 2: The PIXL sensor head shown with the cover open (a) and closed (b)

The PIXL Optical Fiducial system (OFS) enables the measurement of surface distance and surface topography. This system utilizes a coarse and fine structured light illuminator (SLI), which is a device that shines laser spots onto the target in a specific pattern. The MCC acquires high-resolution images of the surface with the laser pattern illuminating the surface. The PIXL Instrument Flight Software (iFSW) then uses this information to determine the distance to the target surface at the location of the X-ray spot.

The PIXL Sensor Assembly houses the primary sensors, detectors and X-ray source used for PIXL science. Specifically, the Sensor Assembly houses the 28 kV High Voltage Power Supply (HVPS) which contains both a High voltage Multiplier Module (HVMM) and a Low Voltage Control Module (LVCM). This system energizes the X-ray tube which focuses the resultant X-rays through the X-ray optic and on to the target surface. Two Silicon Drift Detectors (SDD) collect the X-rays fluoresced from the target, enabling chemical analysis of the surface.

The MCC camera, X-ray optic, SDDs, and structured light illuminators are mounted to the sensor head and share a single cover (shown in Figure 3). The flood light illuminators encircle the sensor head cover.

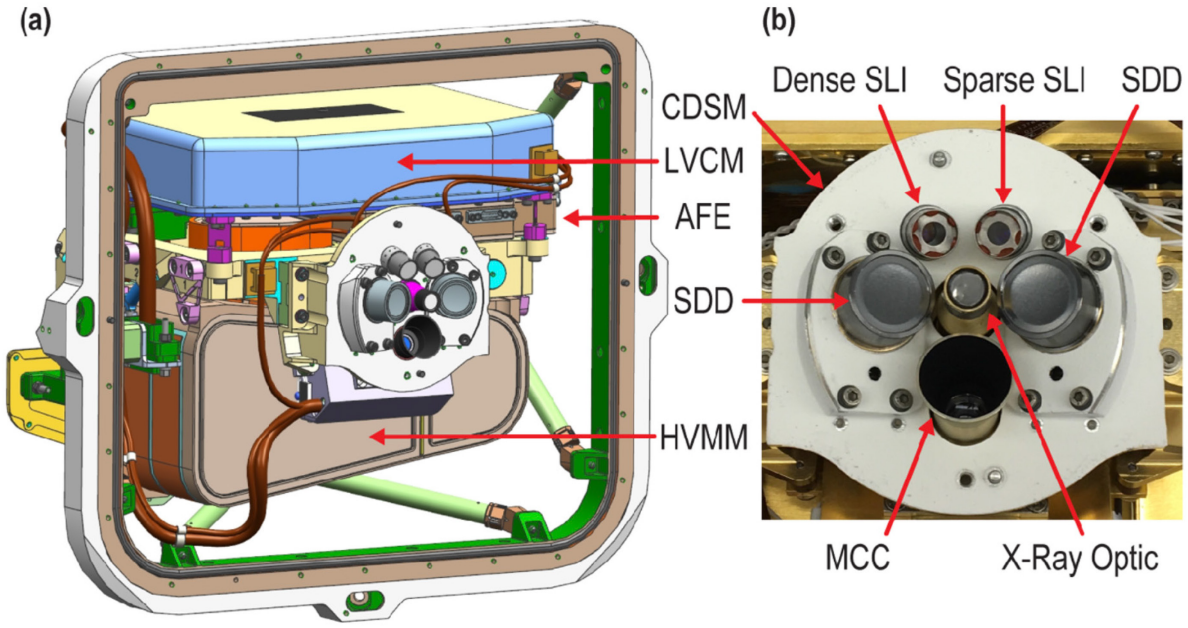


Figure 3: The PIXL sensor head showing the internal X-ray optic, X-ray detector, and imaging component of the instrument

PIXL also includes an on-board calibration target, which is measured by PIXL periodically to evaluate the state of health of the instrument and revise quantification configuration and calibration parameters. The PIXL calibration target is presented in Figure 4 below, which includes a Polytetrafluoroethylene (PTFE) disk (lower left disk) to provide broadband X-ray backscatter, basaltic standard BHVO-2 (upper left), NIST-610 glass (upper right), scapolite (lower left). The central cross contains a chromium line and a nickel line (200 µm across), used for positional characterization. A pseudo-random distribution of black dots serves as a calibrant for the MCC SLI for distance measurements.

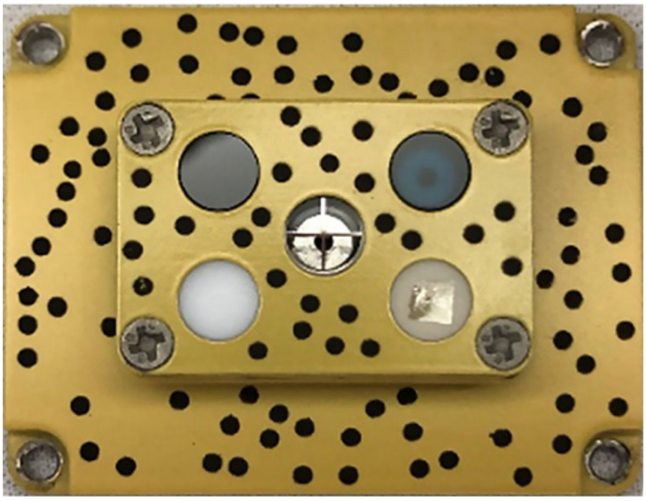


Figure 4: The PIXL calibration target

Each time an X-ray histogram is acquired, histogram data is saved for each detector separately, saved in EDR (ENA, ENB, EDA, EDB product IDs) files and RDR (RFS product ID) files. The iSDS pipeline maps the X-ray spot locations onto the MCC images to determine where the X-ray spots intersect with the target. This position data is stored in the RXL RDR file. **It is anticipated that the primary data products needed by a PIXL data user will be the RFS and RXL RDR files,** however all files are described in this document in Section 3 and 4, and in the PIXL SIS documents ([8, 9]).

A detailed description of the PIXL instrument and its operation is described in Document [11].

1.3. Typical PIXL Activities

PIXL uses a line, map, or grid template to command the instrument to each position, incrementing the PMC each time the hexapod moves. A typical scan sequence runs through the following elements in order, described in detail below. Note, many PIXL sequences may deviate from this typical plan to include additional image acquisitions, drift-corrections, and OFS corrections. A detailed description of a PIXL activity is presented in Section 2.7 of Document [11].

- Landmark detection: MCC images are acquired to refine PIXL placement
- Move to scan center, acquire MCC image and structured light image
- Move to scan start, acquire MCC image and structured light image, perform OFS correction
- Acquire histogram at each point
    - Periodically:
        - Acquire MCC image
        - Acquire structured light-illuminated images
        - Perform OFS correction, drift correction, and/or enable dwell spectra acquisition
- Move to scan center, acquire MCC image and structured light image

The activities performed at each PMC are included in the bitmask in the scan log product (E34 product ID), defined as follows:

Histogram	0x00010000
OFS Correct	0x00020000
TRN Correct	0x00040000
Metrology Pause	0x00080000
JPG Context Image	0x00100000
JPG Periodic Image	0x00200000
ROI Image	0x00400000
UNC Context Image	0x00800000
JPG SLI A Image	0x01000000
JPG SLI B Image	0x02000000

JPG SLI A Struct	0x04000000
JPG SLI B Struct	0x08000000
Unreachable	0x10000000
NTE Violation	0x20000000

PIXL scans typically begin with a Landmark Detection – on Sol N, a mosaic of MCC images collected at the nominal 25 cm working distance serve as a reference image for the PIXL uplink team to use to select a target location. On Sol N+1, PIXL collects an MCC image of the planned target, and uses an onboard feature tracking algorithm to determine how far PIXL has been placed from the target position, and adjusts the hexapod positions to place the PIXL sensor head at the proper scan position.

Once in the proper position, an MCC image is acquired of the center of the planned mapped workspace, the hexapod positions the X-ray source at the start of the scan, and a new MCC image and a dense structured light image to perform an OFS correction (creating a shift in the z-axis to properly focus PIXL) are collected. At this point, PIXL begins stepping through the map, acquiring X-ray fluorescence spectra. The hexapod is moved to the next position in the scan, and a new histogram is acquired until the map is complete.

Periodically, throughout this scan, additional MCC images are acquired, and additional dense or sparse structured light images are acquired to perform OFS corrections as needed. TRN drift-correction may also be applied to account for any robotic arm drift that may occur over the course of the scan, identified by comparing feature locations in MCC images. Dwell spectra (histograms with longer integration times) may also be acquired periodically based on internal processing that reveals the presence of trace elements or other spectral features of interest. An example grid scan template is shown in Figure 5.

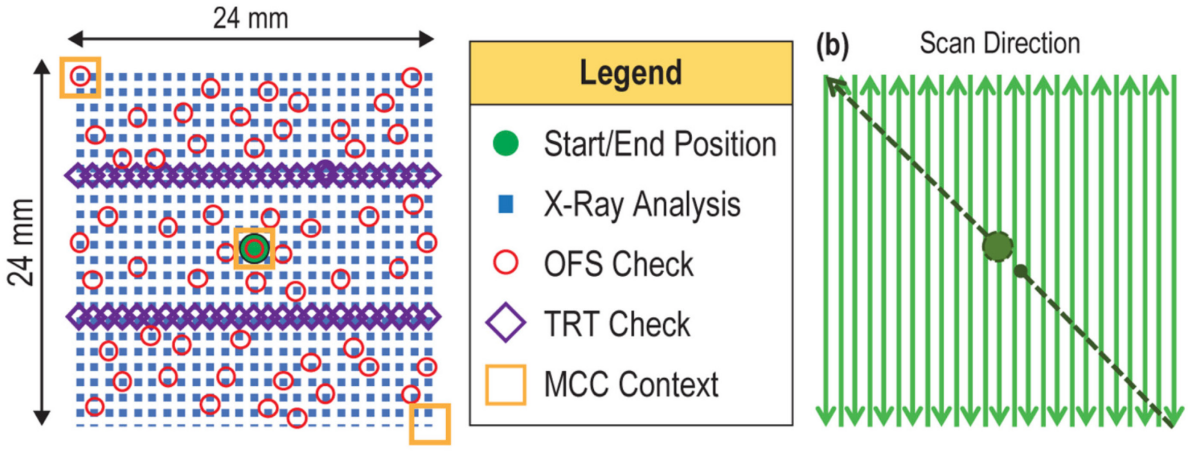


Figure 5: An example grid scan activity consisting of a 25×25 grid in which rows and columns are 24 mm long and spaced 1 mm apart.

1.4. PIXL Data Products

The PIXL ground processing tools generate two types of data products that are archived in the PDS:

- EDRs (Engineering Data Records) – raw, un-calibrated data products
- RDRs (Reduced Data Records) – calibrated and/or processed data products. RDR products are generally the products a PIXL data user will use for analysis of a target.

Each of the PIXL EDR and RDR products are described in detail in the EDR/RDR SIS (Documents [7] and [8]) and summarized below in Section 3 and 4.

The PIXL data products follow the M2020 filename convention. See Appendix A for a detailed description of each of these filename fields.

Filename Prefix:

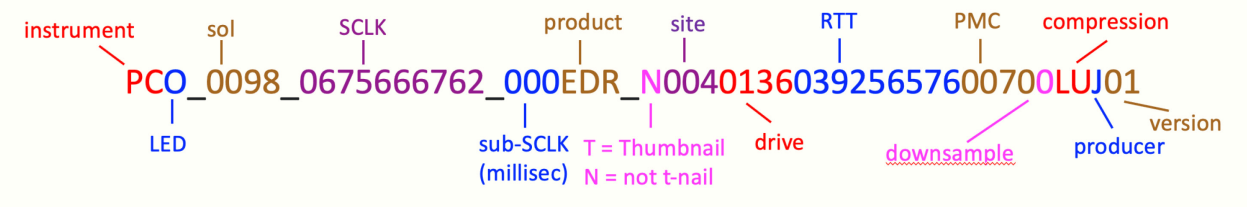
- PC: PIXL Camera
- PE: PIXL Engineering
- PS: PIXL Spectrometer

Product ID:

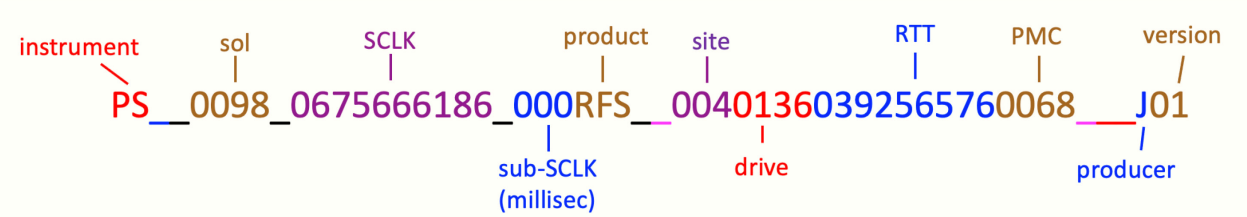
Values	Description
E08	Housekeeping Frame
ENA	Histogram Normal A
ENB	Histogram Normal B
EDA	Histogram Dwell A
EDB	Histogram Dwell B
EPN	PseudoIntensity Normal
EPD	PseudoIntensity Dwell
EMA	Hist Max Val A
EMB	Hist Max Val B
EBA	Hist Bulk Sum A
EBB	Hist Bulk Sum B
E34	Scan Log
ESO	MCC OLM TRN Estimate
ESF	MCC SLI Estimate
EDR	MCC Image
RBQ	Histogram Bulk Quantitative Measurement
RBS	Histogram Bulk Summed Spectrum A/B
RCI	MCC Context Image
RCM	MCC Context Image w/ Mark-up
RCS	Rock Component Sums
RFS	Localized Full Spectra

RMS	Histogram Bulk Max Value A/B
RPM	PseudoIntensity Plots/Maps
RXL	Drift Corrected X-ray Beam Locations
R08	Engineering Value Housekeeping Frame
RBQ	Histogram Bulk Quantitative Measurement
RBS	Histogram Bulk Summed Spectrum A/B

Example filenames:
The example below shows a PIXL imaging file name, along with descriptions of character groups.



The example below shows a PIXL spectroscopy file name, along with descriptions of character groups.



1.5. The PIXL Archive Bundle

The data acquired by PIXL is archived in the PDS within the **mars2020_pixl** bundle. The bundle contains collections of PIXL products based on data processing level and type. Within data collections, products are sorted into subdirectories by Sol number. Products in the sub-directories are identified by the three-letter code found in positions 24-26 of the file name. Based on the PIXL operations plan, it is likely that records in a data file will span more than one Sol. Products are placed in a Sol sub-directory based on the sclk time of the first record in the file.

The structure of the **mars2020_pixl** bundle is:

mars2020_pixl
- data_raw_ancillary
  - sol_xxx
    - E08 – Housekeeping
    - E34 – ScanLog
    - ESO – TRN Estimates
    - ESF – SLI Estimates

data_raw_spectroscopy
- sol_xxx
  - ENA, ENB – Histogram Normal
  - EDA, EDB – Histogram Dwell
  - EPN - Pseudointensity Normal
  - EPD - Pseudointensity Dwell
  - EMA, EMB - Histogram Max Value
  - EBA, EBB – Histogram Bulk Sum

data_raw_imaging
- sol_xxx
  - EDR – Context Images

data_processed
- sol_xxx
  - RBQ- Histogram Bulk Quantitative Measurement
  - RBS – Histogram Bulk Summed Spectra
  - RCI – Context Image
  - RCM – Context Image with Mark-up
  - RCS- Rock Component Sums
  - RFS – Localized Full Spectra
  - RMS- Histogram Bulk Max Values
  - RPM- PseudoIntensity Plots/Maps
  - RXL – Drift Corrected X-ray Beam Locations
  - R08 – Engineering value Housekeeping

Document
- PIXL Calibration Package Documentation
- PIXL EDR SIS
- PIXL RDR SIS
- PIXL Bundle SIS

1.6. Relationships Between Products

The relationship between data products collected by the PIXL instrument can be determined based on the Round-Trip Tracking (RTT) characters assigned to all products collected during the same PIXL observation set. There are several ways that these characters are indicated.

1. PIXL Filenames: The PIXL-specific RTT characters are indicated in PIXL file names by the 9-character string starting at place 36 in the name string. For example:
   a. pe__d144t0654662877_000rxl_n0010000550000453**00070**__j01.csv
   b. pe__d144t0654662877_000rxl_n0010000550000453**00070**__j01.xml
   c. ps__d144t0654662877_000rcs_n0010000550000453**00000**__j01.csv
   d. ps__d144t0654662877_000rcs_n0010000550000453**00000**__j01.xml
   e. ps__d144t0654662877_000rfs_n0010000550000453**00000**__j01.csv
   f. ps__d144t0654662877_000rfs_n0010000550000453**00000**__j01.xml

2. PIXL PDS4 XML Labels: The PIXL RTT can be found in the <geom:Motion_Counter> attribute within the PIXL_Parameters Class. A user who is looking for all products that

are related to a single PIXL X-ray scan can search the PIXL bundle for all products with the same PIXL RTT to get the complete package of information for a single scan.

3. PIXL PDS4 XML Labels: The <mars2020:pixl_motion_counter> found in the PIXL_Parameters Class can also be used to relate data products. The PIXL motion counter is used to identify a unique position within a PIXL scan.

2. Documents

These publications or websites describe the Planetary Data System Standards used to produce the PIXL archive. These documents are archived in the PDS system and are not found specifically in the PIXL archive.

[1] PDS4 Concepts Document, version 1.15.0.0, October 6, 2020, https://pds.nasa.gov/datastandards/documents/concepts/.
[2] Planetary Data System Standards Reference, version 1.15.0.0, October 2, 2020, https://pds.nasa.gov/datastandards/documents/sr/.
[3] Planetary Data System Data Provider's Handbook, version 1.15.0.0, October 2, 2020, https://pds.nasa.gov/datastandards/documents/dph/.
[4] PDS4 Common Data Dictionary, Abridged, version 1.15.0.0, December 23, 2020, https://pds.nasa.gov/datastandards/documents/dd/.
[5] PDS4 Information Model Specification, version 1.15.0.0, December 23, 2020, https://pds.nasa.gov/datastandards/documents/im/.

These documents describe the specifics of the archive and the archive data products, and can, with the exception of [6] be found in the PIXL document collection (i.e. mars2020_pixl:document). [6] can be found in the Mars2020 mission document collection (i.e. mars2020:document)

[6] Mars 2020 Project Archive Generation, Validation and Transfer Plan, JPL D-95520, December 8, 2015 (preliminary, to be updated).
[7] Mars 2020 (M2020) Software Interface Specification: PIXL Instrument Experiment Data Record (EDR) Data Products for Non-Imaging Components, JPL D-99963, January 29, 2021.
[8] Mars 2020 Software Interface Specification Planetary Instrument for X-ray Lithochemistry (PIXL) Reduced Data Products, JPL D-105236, January 22, 2021.
[9] Mars 2020 Software Interface Specification Camera Instrument Data Products, JPL D-99960, December 21, 2020.

These papers describe in detail the Mars 2020 mission and the PIXL instrument. These papers are published with open access and can be downloaded by following the DOI.

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

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

3. Raw Products

The PIXL raw data products are uncalibrated products, generally these products are in units of digital number as reported by the instrument.

3.1. Raw Ancillary Products

There are four types of PIXL ancillary products. The ancillary products are items that needed to fully understand the state of the instrument or the conditions under which the observations were made. These products can be found in the **mars2020_pixl: data_raw_ancillary** collection The ancillary products are:

1. **HK FRAME (E08)** -The HK Frame product is an ASCII CSV table that records the state of the instrument (e.g. temperatures, voltages, currents etc.) at the time of each observation. Each data product is a collection of records from a single PIXL scan.

2. **SCAN LOG (E34) -** PIXL records the actual (drift-corrected) hexapod coordinates for each hexapod movement. The format of this product is a variable record binary table.

3. **MCC OLM TRN ESTIMATE (ESO) -** The translation relative navigation data from the MCC is collected to be used for thermal drift correction. The product is formatted as an ASCII CSV table.

4. **MCC SLI ESTIMATES** (**ESF**)- The ESF product records the distance and plane solutions derived from the Structured Light Illuminator (SLI, a device that shines laser spots onto the target in a specific course or fine pattern) measurements. The product is formatted as an ASCII CSV table.

3.2. Raw Spectral Products

PIXL records six different types of raw spectral data products for each of the two (A and B) x-ray detectors. All products are found in the **mars2020_pixl: data_raw_spectroscopy** collection. The six raw spectral product types are:

1. **HISTOGRAM NORMAL (ENA, ENB**) – The normal histogram is the histogram collected at the nominal dwell time of ten seconds from the indicated (last letter in name code) X-ray detector. The dwell time is the amount of time spent performing an XRF measurement at a single location. Dwell time is recorded as the 'REAL_TIME', in field number 5 of the CSV data product. The CSV product contains 15 fields of header information and 4096 channels of the spectrum with one record for each measurement in the scan.

2. **HISTOGRAM DWELL (EDA, EDB**) – The dwell histogram is the histogram collected at a longer dwell time from the indicated (last letter in name code) X-ray detector.

Longer dwell times are determined by ab algorithm designed to trigger longer duration dwells than the nominal dwell duration. Dwell time is recorded as the 'REAL_TIME', in field number 5 of the CSV data product. The CSV product contains 15 fields of header information and 4096 channels of the spectrum with one record for each measurement in the scan.

3. **PSEUDOINTENSITY NORMAL (EPN)** – The pseudointensity data for each nominal-dwell X-ray histogram is calculated onboard. This product is 32 channels of summed spectrum data of background subtracted XRF intensity values taken over selected detector channel ranges. The pseudointensity (PI) product is a CSV file of sclk, pmc, and 32 channels of PI data with one record for each measurement in the scan.

4. **PSEUDOINTENSITY DWELL (EPD)** – The pseudointensity data for each longer-dwell X-ray histogram calculated onboard. This product is 32 channels of summed spectrum data of background subtracted XRF intensity values taken over selected detector channel ranges. The pseudointensity (PI) product is a CSV file of sclk, pmc, and 32 channels of PI data with one record for each measurement in the scan.

5. **HISTOGRAM MAX VALUE (EMA, EMB**) - Maximum Value Spectrum (maximum measured value for each channel in the set of spectra for this target) for the indicated X-ray detector. The max value histogram is a single spectrum CSV with 12 rows of header data followed by 4069 histogram data rows.

6. **HISTOGRAM BULK SUM (EBA, EBB)** – The bulk sum histogram from the indicated detector. The bulk sum is the sum of all spectra collected in one scan. The bulk sum histogram is a single spectrum CSV with 12 rows of header data followed by 4069 histogram data rows.

3.3. Raw Image Products

The PIXL Micro Context Camera (MCC) is an imager co-mounted with the PIXL spectrometers. It is used to take "basemap" images of each sample scan site. All products are found in the **mars2020_pixl: data_raw_imaging** collection. There are two types of PIXL raw images:

1. **MCC JPEG IMAGE (EDR) -** JPEG compressed context image converted to Array_2D_Image.

2. **MCC RAW BITMAP IMAGE -** Uncompressed MCC images (raw bitmaps).

4. Calibrated Products

The PIXL calibrated data products are calibrated products. Generally. these products are reported in physical units. All calibrated products can be found in the **mars2020_pixl: data_processed** collection:

1. **MCC CONTEXT IMAGE (RCI)** - Images taken by the Micro-Context Camera (MCC) at the center location of the scan, typically with one captured before the scan starts and another after the scan completes. The image is annotated with the X-ray shot locations to allow PIXL scientists to more easily associate each X-ray histogram with the corresponding position on a target

2. **ENGINEERING VALUE HOUSEKEEPING FRAME (R08) -** The HK Frame product is an ASCII CSV table that records the state of the instrument (e.g. temperatures, voltages, currents etc.) at the time of each observation. The R08 product contains the data converted from Digital Number to Physical Unit. Each data product is a collection of records from a single PIXL scan.

3. **DRIFT CORRECTED X_RAY BEAM LOCATIONS (RXL)** - A CSV file containing a set of (x, y, z) positions in the PIXL base frame of each X-ray Beam location on the target surface and the corresponding location in the MCC image (as pixel coordinates), corrected for thermal drift of the robotic arm position or other unexpected motion.

4. **HISTOGRAM BULK MAX VALUE SPECTRUM (RMS**) - Maximum Value Spectrum (maximum measured value for each channel in the set of spectra for this target) with energy calibration. The product format is a .MSA file containing a header and a series of rows representing the energy-calibrated bulk sum spectra. Each row contains two integer values (comma-delimited), representing intensity at each channel for each detector.

5. **HISTOGRAM BULK SUMMED SPECTRUM (RBS)** - Bulk Sum Spectrum (one for each target, all PIXL point spectra for this target summed) with energy calibration. The product format is an MSA file containing a header and a series of rows representing the energy-calibrated bulk sum spectra. Each row contains two integer values (comma-delimited), representing intensity at each channel for each detector.

6. **LOCALIZED FULL SPECTRA (RFS**) - XRF spectrum for each measured location on the target with energy calibration, spatial location, and pixel location in context image. The product format is CSV.

7. **MCC CONTEXT IMAGE WITH MARKUP (RCM) -** Annotated images showing X-ray beam locations as an overlay, with the (x, y) pixel positions of each X-ray beam location marked on the overlay. The images are stored as a multi-layer .TIF file, with the first layer containing the greyscale MCC context image and the second layer containing an image with X-ray bean locations (pixel value 255).

8. **PSEUDOINTENSITY PLOTS/MAPS (RPM)-** The pseudointensity values are generated from on-board processing algorithms, which calculate spectral backgrounds, subtract the background, and calculate the integrated intensity for a region

associated with up to 32 elements lines. The product CSV file contains two tables, a position table and a pseudointensity data table.

5. Derived Products

There are two derived products that are planned. These products are also found in the **mars2020_pixl: data_processed** collection:

1. **HISTOGRAM BULK QUANTITATIVE MEASUREMENT (RBQ**)- This product is a CSV file that contains the results of the quantitative analysis applied to the bulk sum spectrum – a sum of all spectrum intensity values over all points in an observation.

2. **ROCK COMPOSITION SUMS (RCS)**- This product is the elemental composition for user-defined distinct features within a target region. The product is formatted as a six table CSV file.

6. Data Collection and Caveats

6.1. Data Acquisition

Long-duration (several hour) PIXL observations may be commanded during overnight operations, resulting in an experiment starting on Sol N and ending on Sol N+1. In these cases, all PIXL data products (EDRs and RDRs) will use the starting Sol in the Sol field of the filename.

6.2. Pseudointensity Data

Pseudointensity maps are designed to provide PIXL operations team members with high priority, low bandwidth products that will always be available during tactical planning, in cases where full spectral maps may be too large to downlink quickly. Pseudointensity maps provide information necessary to quickly evaluate the success of a scan. In general, PIXL data users are expected to make use of full spectra maps (RFS) or derived quantitative data products (RBQ, RCS) for scientific analysis.

7. Acknowledgements

The research was carried out in part at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration (80NM0018D0004).

Appendix A:

<table>
<tr><th>Characters</th><th>Contents</th><th>Description</th></tr>
<tr><td>1-2</td><td>Instrument</td><td>PE: PIXL Engineering
PC: PIXL Camera
PS: PIXL Spectrometer</td></tr>
<tr><td>3</td><td>Color/Filter</td><td>"_" for PIXL spectroscopy and engineering
For image products, LED state:<table><tr><td>R</td><td>Red</td></tr><tr><td>G</td><td>Green</td></tr><tr><td>B</td><td>Blue</td></tr><tr><td>W</td><td>White (multiple</td></tr><tr><td>U</td><td>UV</td></tr><tr><td>D</td><td>SLI-A (Dense)</td></tr><tr><td>S</td><td>SLI-B (Sparse)</td></tr><tr><td>_</td><td>Off</td></tr><tr><td>O</td><td>Other</td></tr></table></td></tr>
<tr><td>4</td><td>Special Processing Flag</td><td>"_" (none for PIXL)</td></tr>
<tr><td>5-8</td><td>Sol</td><td>Sol number for flight surface data; see EDR SIS for other uses</td></tr>
<tr><td>9</td><td>Mission venue</td><td>"_" for Flight Mode</td></tr>
<tr><td>10-19</td><td>Spacecraft Clock Count (SCLK)</td><td>10-integer spacecraft clock count in seconds</td></tr>
<tr><td>20</td><td>Underscore</td><td>Always "_" for readability</td></tr>
<tr><td>21-23</td><td>Fractional SCLK</td><td>3-digit spacecraft clock count fractional seconds</td></tr>
<tr><td>24-26</td><td>Product Type</td><td>See PIXL Product Type in Table 1</td></tr>
<tr><td>27</td><td>Geometry</td><td>Not used for Spectroscopy, set to "_".

For image products: denote for Geometry
"_" indicates raw (non-linearized) geometry
"L" indicates product has been linearized with nominal stereo partner
"A" indicates product has been linearized with actual stereo partner
"T" indicates trapezoid-corrected image</td></tr>
<tr><td>28</td><td>Thumbnail</td><td>"_" for non-image products
"T": Product is a thumbnail images
"N": Product is not a thumbnail image</td></tr>
<tr><td>29-31</td><td>Site</td><td>Site identifier from Rover Motion Counter</td></tr>
<tr><td>32-35</td><td>Drive</td><td>Drive identifier (position within a site location)</td></tr>
<tr><td>36-44</td><td>RTT</td><td>Each PIXL activity is given a unique 9-digit token to distinguish it from other activities. This RTT is included in the filename of all EDR and RDR products to easily link images, spectra, and housekeeping files associated with a particular measurement.</td></tr>
<tr><td>45-48</td><td>PMC</td><td>This field has the format 'PPPP' representing the PMC. Valid values are 0000-9999.</td></tr>
<tr><td>49</td><td>Downsample resolution</td><td>"_" for non-image data products
For image products:</td></tr>
</table>

Resolution = 2^n x 2^n

Valid values	Resolution
0	1x1
1	2x2
2	4x4
3	8x8
…	...

50-51 Compression

"__" for non-image data products

For image products:

Type	**Valid values**	**Description**
JPEG (lossy)	00 01-99 A0	Thumbnail Jpeg quality level Jpeg quality level 100
ICER (lossy)	I1, I2, …, I8 I9	1 bpp, 2 bpp, …, 8 bpp Anything higher than 8 bpp
Lossless	LI LL LM LU	ICER LOCO Malin Uncompressed

52 Provider

Provider institution ID
J: IDS at JPL
P: Instrument Principal Investigator
Other: Co-investigators as identified at discretion of PI

53-54 Product Version

Product version number. Increments by one whenever a previously generated file with an otherwise identical filename exists.

Values	**Range**
00, 01, 02 …, 99	0 thru 99
A0, A1, …, A9	100 thru 109
AA, AB, …, AZ	110 thru 135
B0, B1, B2 …, B9	136 thru 145
BA, BB, …, BZ	146 thru 171
…	…
Z0, Z1, …, Z9	1000 thru 1009
ZA, ZB, …, ZZ	1010 thru 1035
_ _	Value is out of range

55 Separator

Separator for filename and extension, always "."

56-58 File name extension

"DAT" : Binary table
"CSV" : ASCII comma-separated-value text file
"IMG" : Image data

