

MARS SAMPLE RETURN: SAMPLE DOSSIER ARCHIVE. J. R. Christian¹, T. C. Stein¹, G. Bowen¹, F. J. Calef III². ¹McDonnell Center for the Space Sciences, Dept. of Earth, Environmental, and Planetary Sciences, Washington University in St. Louis, ²NASA Jet Propulsion Laboratory. jchristian@wustl.edu

Introduction: As part of the Mars Sample Return program, the Earth and Planetary Remote Sensing Laboratory at Washington University in St. Louis is contributing to a set of archives to organize and make available scientific, operational, and ancillary data relating to the various samples collected by Mars 2020 *Perseverance* for return to Earth. The second of these archives, the Sample Dossier Archive, will contain science and engineering data related to the acquisition process for all samples. This archive is intended to complement the Three Forks Depot Archive [1], which includes data related to the construction of the Three Forks Depot cache of a subset of samples [2,3].

Data Products: The Sample Dossier Archive will contain four broad categories of data: science observations, localization data, engineering telemetry, and documentation.

Science Observations: As part of the sample acquisition process, *Perseverance* acquires a standardized set of scientific observations. This set of activities, called the Standardized Observation Protocol (STOP list), is intended to ensure a comparable set of observations across all samples [3]. For each STOP list activity, this archive will document the acquisition sol, target, instrument sequence id, and references to key science products.

A typical set of STOP list observations for a rock core sample will include the following:

- Mastcam-Z outcrop-scale imaging and targeted multispectral products
- WATSON images of abrasion and coring targets, acquired both before and after drilling
- SuperCam LIBS and VISIR spectral data
- SHERLOC map of the abrasion patch
- PIXL map of the abrasion patch
- CacheCam images of acquired samples

In addition to science products formally acquired as part of the STOP list, many additional science products were collected that document each sample. Where possible, these additional science products will be identified and documented alongside the STOP list observations for each sample.

Examples of some of these science products are shown in Figure 1.

Localization Data: Several planned localization products will capture details of rover and sample locations, orientations, and arm poses throughout sample collection. These products include:

- Latitude, longitude, elevation, and orientation [6] of each sample pre-acquisition
- Latitude, longitude, and elevation of each abrasion patch
- Latitude, longitude, elevation, orientation, and arm pose of *Perseverance* throughout sample acquisition
- Pre-acquisition 3D meshes of each sample target generated from stereo images

Engineering Telemetry: These products are intended to capture details of the forces and other environmental conditions experienced by each sample during acquisition. They include:

- Force and temperature sensor data
- Actuator rates, torques, and percussion frequency during acquisition
- Volume assessment probe data
- Dust mitigation activity in the Adaptive Caching Assembly
- Regolith sampling percussion events
- Witness tube activation timing and force profile
- gDRT pressure and puff count

Documentation: These products are intended to capture high-level details of each sample acquisition event. They include:

- Names of each sample, the associated abrasion patch, and names of any paired sample acquired in parallel
- Identifiers and serial numbers of each sample tube, seal, seal ferrule, and the drill bit used to acquire each sample
- Locations each sample was kept within the long-term storage rack
- High-level overview of all other science products collected by *Perseverance* at each sample location

Archive and Data Access: Data products and documentation comprising the Sample Dossier Archive will be archived with the PDS Geosciences Node (<https://pds-geosciences.wustl.edu>) [5]. In addition, they will be incorporated into the PDS Analyst's Notebook for Mars 2020 (<https://an.rsl.wustl.edu>) in the sample science section, which contains initial reports for collected samples cross-linked with relevant metadata and images, activity plans, mission lead and documentarian reports, and pre-release collection reports [4].

Timeline: The Sample Dossier Archive, planned to record all available data related to *Perseverance's* acquisition of all sample tubes, is expected to have an initial release in late 2024. Periodic additional releases are anticipated as *Perseverance* continues to collect samples. This archive is intended to complement the Three Forks Depot Archive [1], currently under review, which will record all available information related to the creation of the Three Forks Sample Depot.

References: [1] Christian, J. R. et al. (2024), *LPSC LV*, Abstract #1284. [2] Czaja, A. D. et al. (2023), *LPSC LIV*, Abstract #2523. [3] Herd, C. D. K. et al. (2023), *LPSC LIV*, Abstract #2185. [4] Stein, T. C. and F. Zhou (2024), *LPSC LV*, Abstract #1255. [5] Ward, J. G. et al. (2024), *LPSC LV*, Abstract #1453. [6] Weiss et al. (2024), *Earth & Space Sci.*, DOI 10.1029/2023EA003322

Figure 1. Examples of some of the science products acquired for the paired samples Shuyak (acquired sol 575) and Mageik (acquired sol 579) with associated abrasion patch Novarupta (abraded sol 568).

- Front Hazcam image acquired pre-sampling, showing the locations of Mageik (green, "M"), Shuyak (yellow, "S"), and Novarupta (red, "N"). This image was acquired as part of a stereo pair, providing 3D mesh data that will also be archived.
- CacheCam image showing the Mageik sample post-acquisition (core diameter 13mm). Along with high-resolution WATSON and SuperCam RMI images acquired pre-acquisition, these images will allow returned samples to be oriented.
- Mastcam-Z multispectral image of the Mageik borehole, providing composition information of the drill tailings.
- WATSON image of the Novarupta abrasion patch (abrasion diameter 5cm). Approximate locations of PIXL scans (blue boxes), SHERLOC scans (white boxes), and SuperCam IR measurements (green circles; SuperCam also acquired LIBS and visible spectra from overlapping points) are shown. The two scans circled in red are formally part of the STOP list suite; the other scans (plus additional scans by each instrument acquired pre-abrasion) are not, but will be included in the archive as well.

Each instrument acquired many more science products before and after abrasion and coring, which will be documented in the archive.

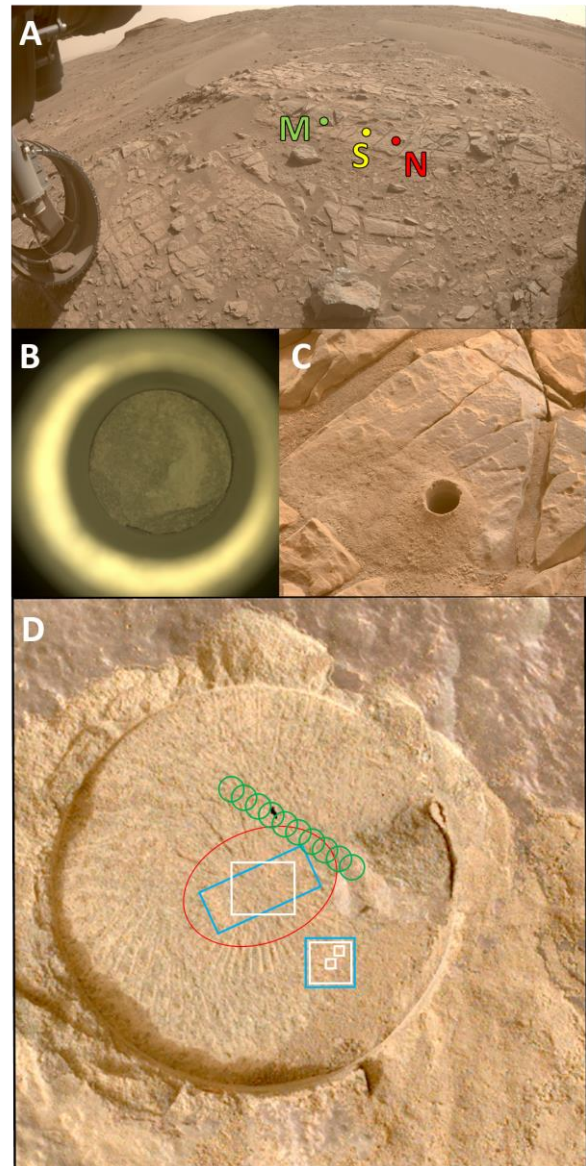


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