Documenting Sampling by the NASA Perseverance Mission: In Support of Mars Sample Return.

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Introduction: A primary goal of the NASA Mars 2020 Perseverance rover mission is to select, acquire, and document a scientifically return-worthy collection of martian samples for return to Earth by future missions [1]. Perseverance is currently exploring Noachian-aged Jezero Crater, once the site of a delta-lake system with a high potential for habitability. Perseverance carries 38 identical sample tubes designed for rock core or regolith, and five "witness tubes" for characterizing contamination from the rover. As of the completion of the Crater Floor Campaign in mid-March, 2022, Perseverance has sealed 10 tubes: 8 rock cores, one tube in which inadvertently no core was acquired but which does include a serendipitous sample of ~5 μmol of ambient atmosphere (Table 1), and one witness tube. Here we provide an overview of the characterization and documentation acquired during each sample collection. The Sampling and Caching Subsystem (SCS) is fully decribed by [2].

Table 1: List of samples collected by Perseverance as of the end of the Crater Floor Campaign

Location	Abrasion Target	Samples	Sampling Sols	Stratigraphic context (Formation/Member)
Roubion	Guillaumes	Roubion*	164	Máaz/Roubion
Rochette	Bellegarde	Montdenier, Montagnac	190, 196	Máaz/Rochette
Brac	Dourbes	Salette, Coulettes	262, 271	Séítah/Bastide
Issole	Quartier	Robine, Malay	295, 337	Séítah/Issole
Sid	Alfalfa	Hahonih, Atsah	371, 377	Máaz/Ch'ał

The "STOP: List: During mission operations, a standardized set of required activities and observations are undertaken to fully document a sample, once the sampling target has been identified. These activities are called the Standardized Observation Protocol, or STOP list. The STOP list includes imagery at multiple scales along with chemical and mineralogical analyses of the outcrop surface. Because rock surfaces are frequently coated with dust or other materials, an ~1 cm deep and 5 cm diameter Abrasion Target is acquired within a few tens of cm of the sample target within the same lithology (Table 1). In this "sample proxy" patch, high-resolution images and detailed maps of elemental composition, mineralogy and potential organic matter are obtained. After coring, an image is taken of the sample in the tube, the amount of sample is estimated, and the tube is hermetically sealed [2]. Unique serial numbers are readily visible on the tube and seal exteriors to ensure confident identification even decades after acquisition.

Sample documentation: Each sample is documented by the following products:

Sample Dossier: Contains all observations from the STOP list, along with relevant rover data (e.g., temperatures, rover location, rover arm position and actions, etc). Uploaded to the NASA Planetary Data System (PDS) on a regular cadence, the *Sample Dossier* primarily consists of pointers to instrument-specific and engineering data products. These data are independently delivered to the PDS, and thus the dossier acts as a "one stop shop" for sample-specific results.

Initial Report: A description of each sample in a standardized narrative format is written by the Science Team within three weeks of sample acquisition to capture the reasons for sampling and describe the interpretations available at the time of sampling and the completion of the STOP list. The *Initial Report* can be thought of as a set of field notes associated with each sample. *Initial Reports* are archived in the NASA PDS as an element of each *Sample Dossier*. The first volume of the Mars 2020 *Initial Reports* has been delivered to the NASA PDS; this volume includes the first four tubes collected during the Crater Floor Campaign: specifically, the Bit Carousel Witness Tube (see [2] for details); and the tubes containing Roubion, Montdenier and Montagnac (Table 1).

Like field notes, the *Initial Reports* do not include extensive assessment and interpretation of the collected samples; these are reported elsewhere. The mineralogy, petrology and geochemistry of the first several samples collected during the Crater Floor Campaign, as well as the stratigraphy of crater floor units, can be found in [3,4]. Implications for Returned Sample Science are provided by [5]; comparisons with martian meteorite lithologies are provided by [6, 7].

References: [1] Farley K.A. et al. (2020) *Space Science Reviews*, 216. [2] Moeller R.C. et al. (2021) *Space Science Reviews*, 217. [3] Farley K.A. et al. (submitted). [4] Liu Y. et al. (submitted). [5] Cohen B.A. et al. (2022) *This meeting*. [6] Udry A. et al. (2022) *This meeting*. [7] Treiman A.H. et al. (2022) *This meeting*.