Geophysical Research Abstracts
Vol. 20, EGU2018-4823-1, 2018
EGU General Assembly 2018

An Overview of the Comet Astrobiology Exploration Sample Return (CAESAR) New Frontiers Mission

Daniel Glavin (1), Steven Squyres (2), and the CAESAR Project Team

(1) NASA Goddard Space Flight Center, Solar System Exploration Division, Greenbelt, MD, United States (daniel.p.glavin@nasa.gov), (2) Cornell University, Ithaca, NY, United States (squyres@astro.cornell.edu)

The Comet Astrobiology Exploration Sample Return (CAESAR) mission was recently selected by the NASA New Frontiers Program for Phase A study. CAESAR will acquire and return to Earth for laboratory analysis a minimum of 80 g of surface material from the nucleus of comet 67P/Churyumov-Gerasimenko (67P). CAESAR will characterize the surface region sampled, preserve the collected sample in a pristine state, and return evolved volatiles by capturing them in a separate gas reservoir. NASA Goddard provides project management, systems engineering, safety and mission assurance, contamination control, mission operations, and many other important functions. Orbital ATK develops the spacecraft, based on Dawn mission heritage, which like CAESAR uses solar electric propulsion.

Collection of a sample from the surface of comet 67P is facilitated by a set of cameras that together provide images to support sample site selection, perform optical navigation, and document the sample before, during, and after collection. The sample is collected at the end of an arm during a 5 second touch-and-go maneuver (TAG) with the Sample Acquisition System (SAS) designed by Honeybee Robotics for the surface properties of comet 67P observed by the Rosetta/Philae mission. After sample collection, and while the sample is still cold (< -80°C), the TAG Arm inserts the sample container into the Sample Containment System (SCS) mounted inside the Sample Return Capsule (SRC). The SCS seals the sample, preventing material from escaping into space. The sample is slowly warmed inside the SCS to enable sublimation of volatiles which are collected in a passively cooled gas reservoir called the Gas Containment System (GCS), separating the volatiles from the solid sample and thereby protecting the solid sample from alteration. Once H_2O has sublimated from the solid sample, the GCS is sealed to capture the volatiles it contains, and the SCS is vented to space to maintain the solid sample under vacuum. The SCS vent is closed before Earth entry to prevent atmospheric contamination.

The CAESAR SRC is provided by the Japanese Aerospace Exploration Agency (JAXA). Its design is based on the SRC flown on the Hayabusa and Hayabusa2 missions. The SRC lands at the Utah Test and Training Range (UTTR) and is immediately placed in cold storage for transportation to the NASA Johnson Space Center, where the samples are removed and delivered to a dedicated CAESAR curation facility.

Detailed laboratory analyses of the sample from 67P will trace the history of volatile reservoirs, delineate the chemical pathways that led from simple interstellar species to complex molecules, constrain the evolution of the comet, and evaluate the role of comets in delivering water and prebiotic organics to the early Earth. CAESAR will achieve these goals by carrying out coordinated sample analyses that will link macroscopic properties of the comet with microscale mineralogy, chemistry, and isotopic studies of volatiles and solids. Most of the sample ($\geq$75%) will be set aside for analysis by generations of scientists using continually advancing tools and methods, yielding an enduring scientific treasure that only sample return can provide.