

Comet surface sample return (CSSR)

Comet Surface Sample Return seeks to understand the nature of cometary formation and mixing of materials in the protosolar nebula; compositional reservoirs present in the early solar system; the role of comets in the delivery of water and organic molecules to the early Earth, terrestrial planets and satellites; and evolutionary processes spanning from the protoplanetary disk to current cometary activity. The mission will map the nucleus of a Jupiter family comet, select an optimal sampling site, and acquire a sample from the surface for return to Earth for laboratory analysis. The sample will be acquired and transported in a manner that preserves organics and prevents aqueous alteration of the sample. Volatile material will be characterized via onboard analysis and/or by capture and return at non-cryogenic temperatures.

CSSR Science Objectives:

- Determine the elemental, isotopic and structural composition of the organic and inorganic components of a comet nucleus to understand early compositional reservoirs
- Sample, preserve and analyze cometary organic material to determine how complex organic molecules form and evolve in interstellar, nebular, and planetary environments
- Determine the isotopic composition of cometary water to address the role of comets in delivering volatiles to Earth's atmosphere and interior
- Determine if cometary organic matter contributed significantly to prebiotic chemistry and homochirality of life on Earth

The mission shall address all four objectives.