Project overview of CAESAR comet sample return mission

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The Comet Astrobiology Exploration Sample Return (CAESAR) mission will acquire both rocks and ice with a minimum amount of 80 g from the surface of short-period comet 67P/Churyumov-Gerasimenko and recover the samples to the Earth for laboratory analysis [1]. Since comets preserve the records of the early evolution of solar-system material, analysis of returned samples by CAESAR is expected to uncover the origin of the Solar System starting materials and how these components came together to form planets and give rise to life. ESA's Rosetta mission visited comet 67P and carried out detailed remote sensing observations, which provides us geomorphological information and composition of surface material. Infrared spectra of comet 67P show a large 3 μm absorption band from water ice, while no apparent 2.7 μm absorption band from phyllosilicates [2], which suggests minimum aqueous alteration and thus preservation of intact solid material. CAESAR can take the advantage from the Rosetta results to maximize science return and to reduce the risk for landing. CAESAR preserves much of the science of a cryogenic sample return by retaining volatiles in a dedicated reservoir securely separated from the solid sample.

Analyses of returned samples will determine the nature and abundances of interstellar materials that are present in the solar-system starting material. They will trace the evolution of volatile reservoirs, delineate chemical pathways that led from simple interstellar species to complex and prebiotic molecules, and constrain the geological and dynamic evolution of 67P. And they will evaluate the potential role of comets in delivering water and organics to the early Earth. These goals will be achieved by sample analyses that link macroscopic properties of the comet with microscale mineralogy, chemistry, and isotopic studies of volatiles and solids. These analyses can be performed in terrestrial laboratories with orders of magnitude greater sensitivity and precision than possible with spacecraft instrumentation.

CAESAR is one of the two finalists selected by NASA for Phase A study in the New Frontiers 4 program and the result of the final selection will be in public in late 2019.

References: [1] Squyres S. W. et al. (2018) 49th LPSC, Abstract #1332. [2] Barucci M. A. et al. (2016) A&A 595, A102.