THE CAESAR NEW FRONTIERS MISSION: Overview and Imaging Objectives

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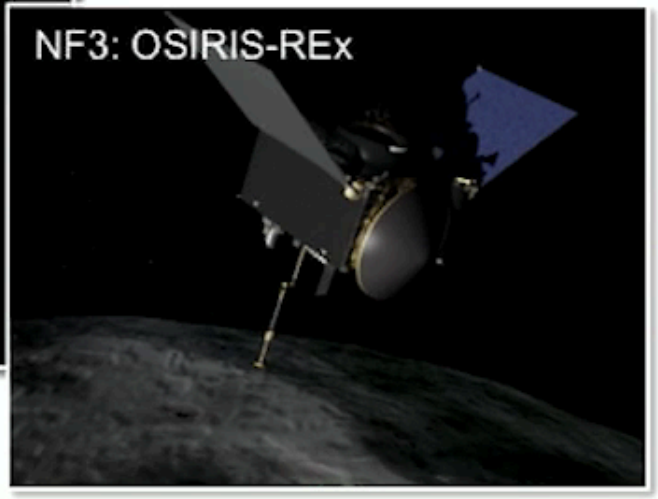
June 18, 2018

Goddard Space Flight Center

Lyndon B. Johnson Space Center

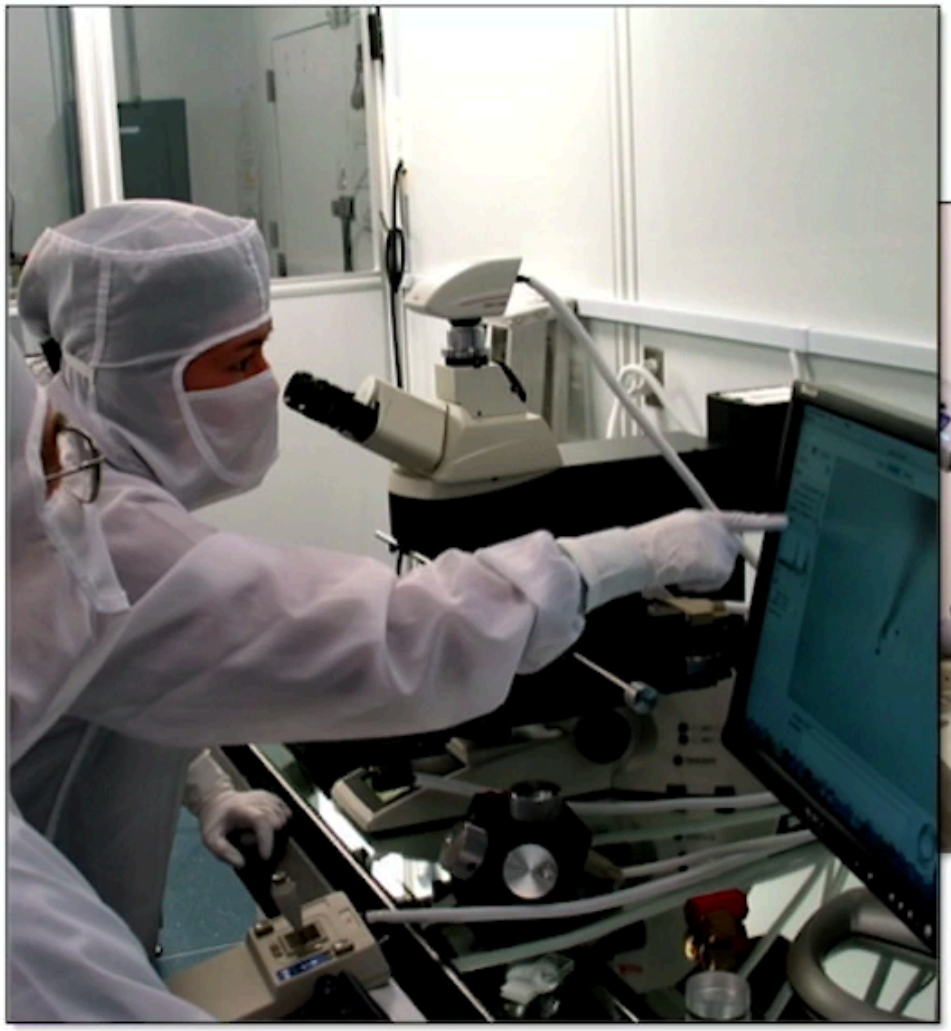
calcon
www.calcon.sdl.usu.edu

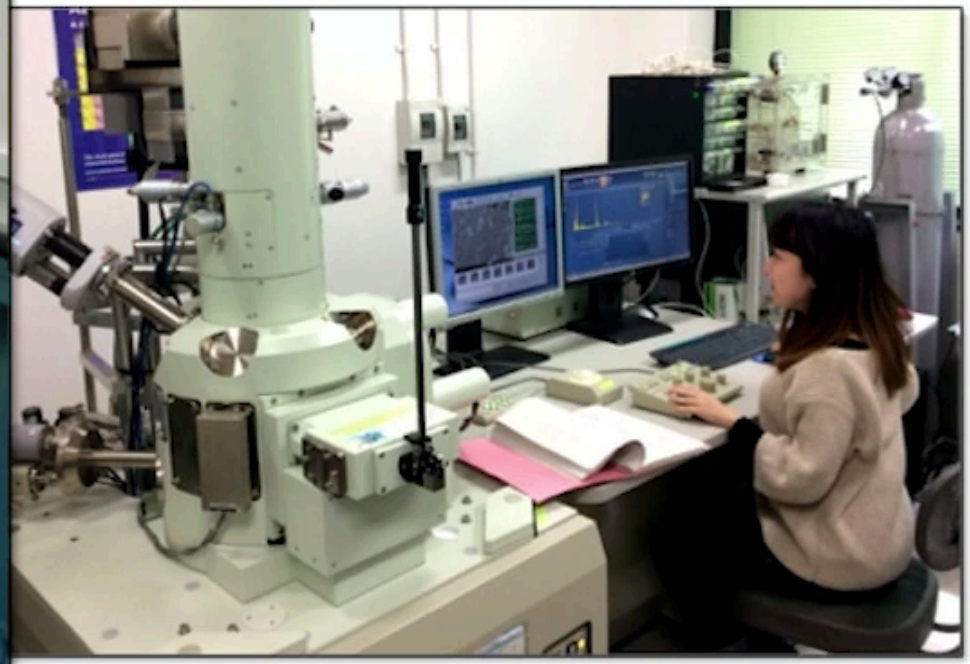
NASA's New Frontiers Program



- Comet Sample Return Mission
- 1 of 12 Missions Proposed to NF4
- 1 of 2 Missions selected for Step 2
- Final down-select summer 2019

Sample Science





CAESAR Sample Science

Dust and molecules formed from dying stars and inter-stellar clouds preserve clues to their origins that can be seen at the atomic scale in Earth laboratories

CAESAR Sample Science

Remnants of the first Solar System solids have been preserved in a deep freeze in comets for billions of years

CAESAR Sample Science

CAESAR will show the nature and origins of prebiotic organic molecules that were delivered to the early Earth by comets

Comet Volatiles

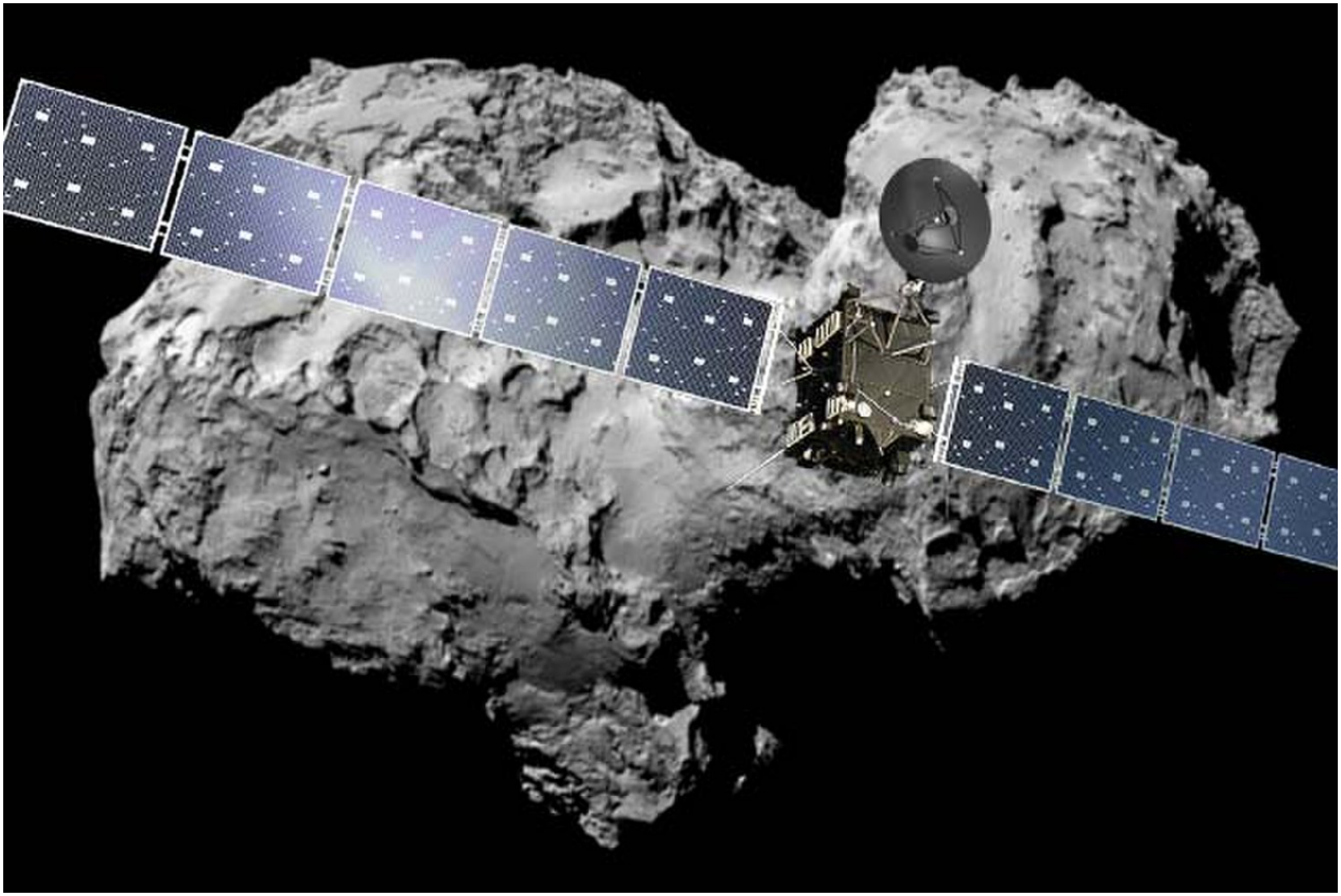
CAESAR Cornerstone Principles

1. Return a sample from comet 67P/Churyumov-Gerasimenko (67P).
2. Use solar electric propulsion to travel to 67P and back, over a wide range of launch dates.
3. Carry only the instruments necessary to successfully acquire, document, and provide context for the sample.
4. Base CAESAR as fully as possible on the OSIRIS-REx mission architecture.

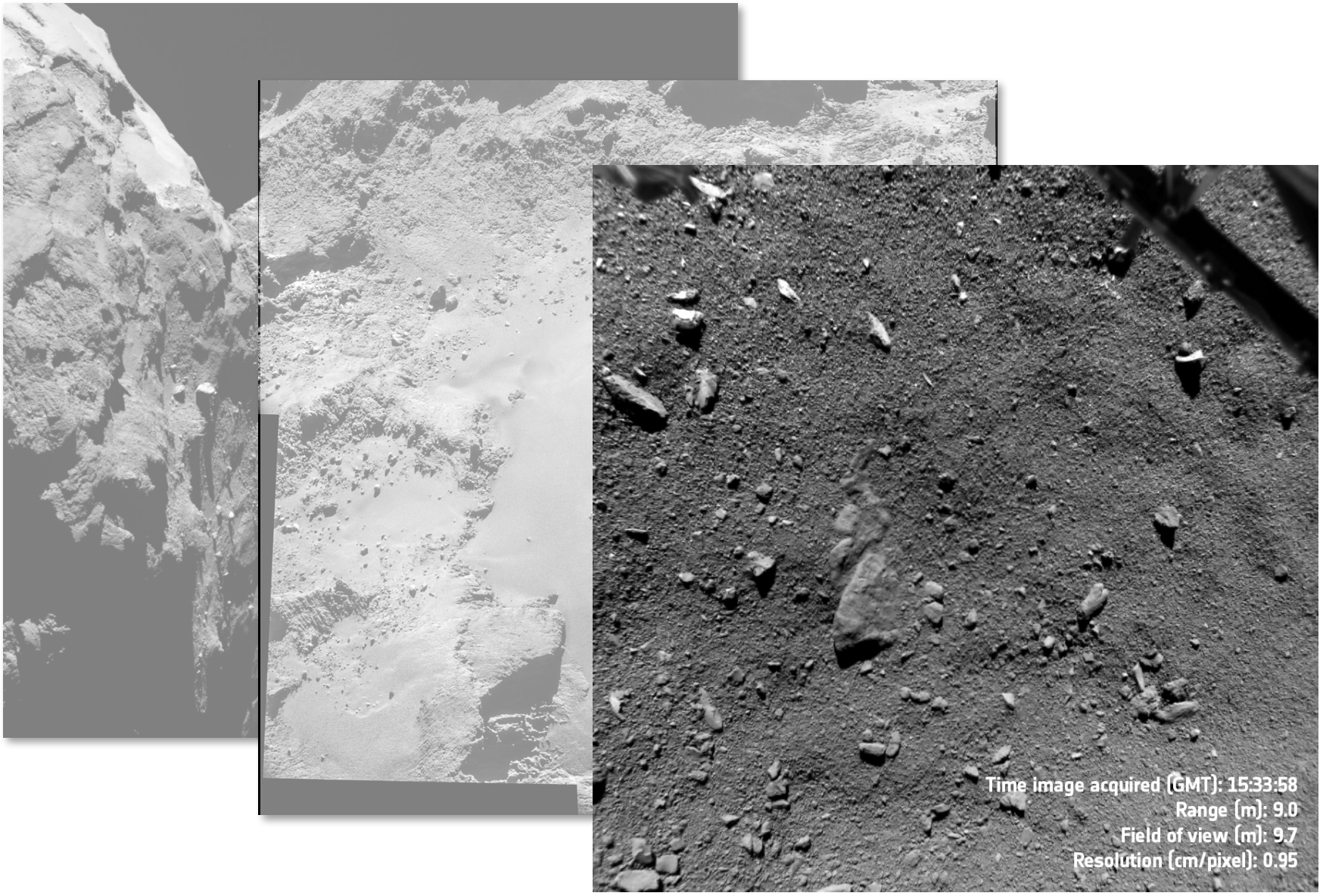
These principles minimize cost and risk, and allow precious resources to be focused on returning a sample of the highest possible scientific value.

CR130

CAESAR's Target: Churyumov-Gerasimenko



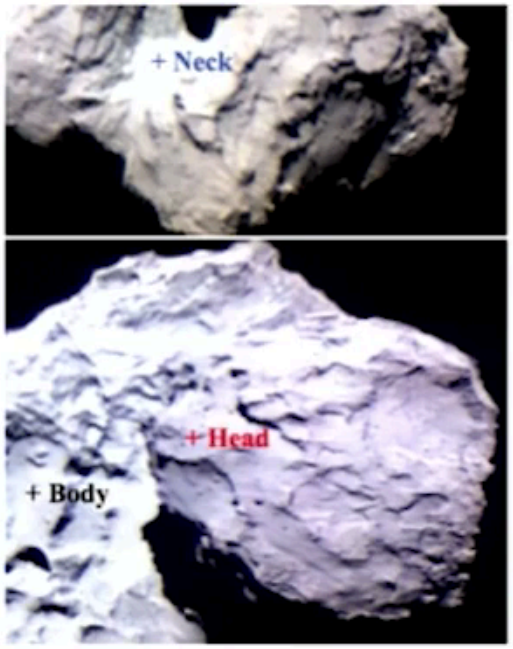
Churyumov-Gerasimenko

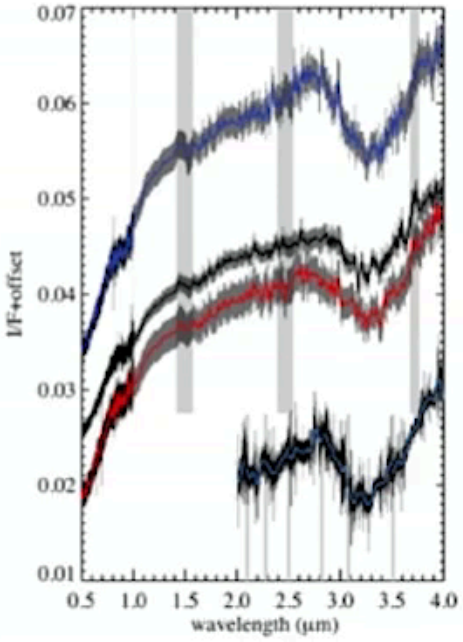


Organics Distribution on 67P

The organic-rich surface of comet 67P/Churyumov-Gerasimenko as seen by VIRTIS/Rosetta

F. Capaccioni,[1*] A. Coradini,[1†] G. Filacchione,[1] S. Erard,[2] G. Arnold,[3] P. Drossart,[2] M. C. De Sanctis,[1] D. Bockelee-Morvan,[2] M. T. Capria,[1] F. Tosi,[1] C. Leyrat,[2] B. Schmitt,[4] E. Quirico,[4] P. Cerroni,[1] V. Mennella,[5] A. Raponi,[1] M. Ciarniello,[1] T. McCord,[6] L. Moroz,[3] E. Palomba,[1] E. Ammannito,[7] M. A. Barucci,[2] G. Bellucci,[1] J. Benkhoff,[8] J. P. Bibring,[9] A. Blanco,[10] M. Blecka,[11] R. Carlson,[12] U. Carsenty,[3] L. Colangeli,[8] M. Combes,[2] M. Combi,[13] J. Crovisier,[2] T. Encrenaz,[2] C. Federico,[14] U. Fink,[15] S. Fonti,[10] W. H. Ip,[16] P. Irwin,[17] R. Jaumann,[3,18] E. Kuehrt,[3] Y. Langevin,[9] G. Magni,[1] S. Mottola,[3] V. Orofino,[10] P. Palumbo,[19] G. Piccioni,[1] U. Schade,[20] F. Taylor,[17] D. Tiphene,[2] G. P. Tozzi,[21] P. Beck,[4] N. Biver,[2] L. Bonal,[4] J.-Ph. Combe,[6] D. Despan,[2] E. Flamini,[22] S. Fornasier,[2] A. Frigeri,[1] D. Grassi,[1] M. Gudipati,[12,23] A. Longobardo,[1] K. Markus,[3] F. Merlin,[2] R. Orosei,[24] G. Rinaldi,[1] K. Stephan,[3] M. Cartacci,[1] A. Cicchetti,[1] S. Giuppi,[1] Y. Hello,[2] F. Henry,[2] S. Jacquinod,[2] R. Noschese,[1] G. Peter,[25] R. Politi,[1] J. M. Reess,[2] A. Semery[2]



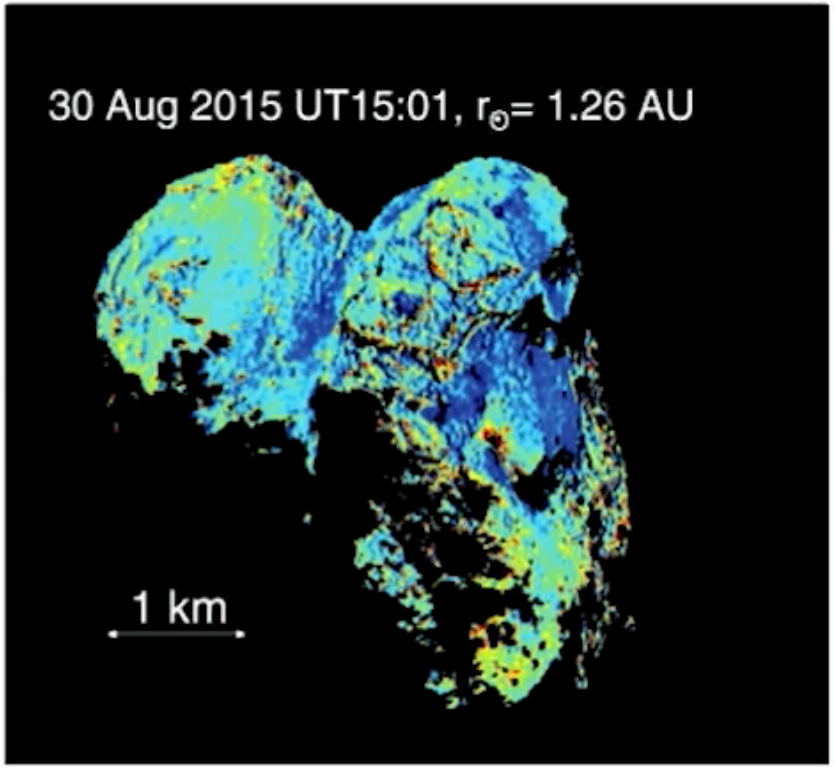


"The very low reflectance of the nucleus (normal albedo of 0.060 ± 0.003 at 0.55 micrometers), the spectral slopes in visible and infrared ranges (5 to 25 and 1.5 to 5% kÅ^{-1}), and the broad absorption feature in the 2.9-to-3.6–micrometer range present across the entire illuminated surface are compatible with opaque minerals associated with nonvolatile organic macromolecular materials: a complex mixture of various types of carbon-hydrogen and/or oxygen-hydrogen chemical groups…"

Ice Distribution on 67P

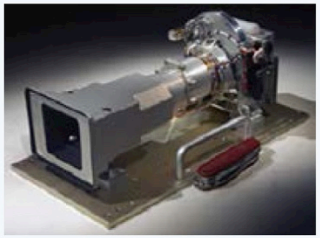
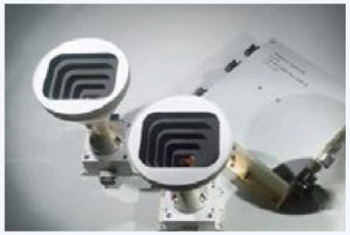
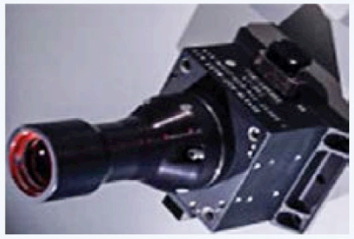
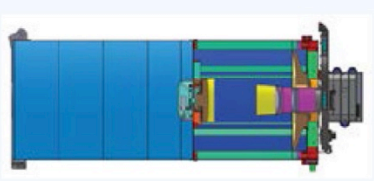
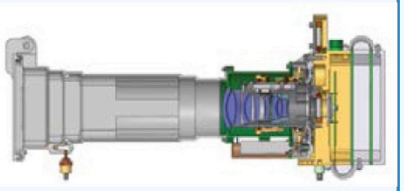
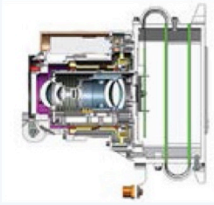
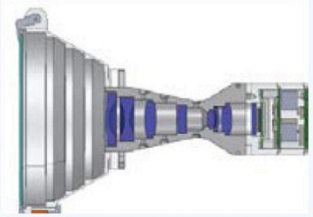
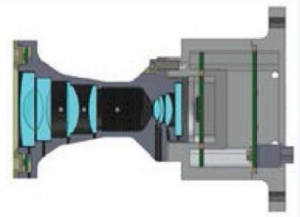
Rosetta's comet 67P/Churyumov-Gerasimenko sheds its dusty mantle to reveal its icy nature

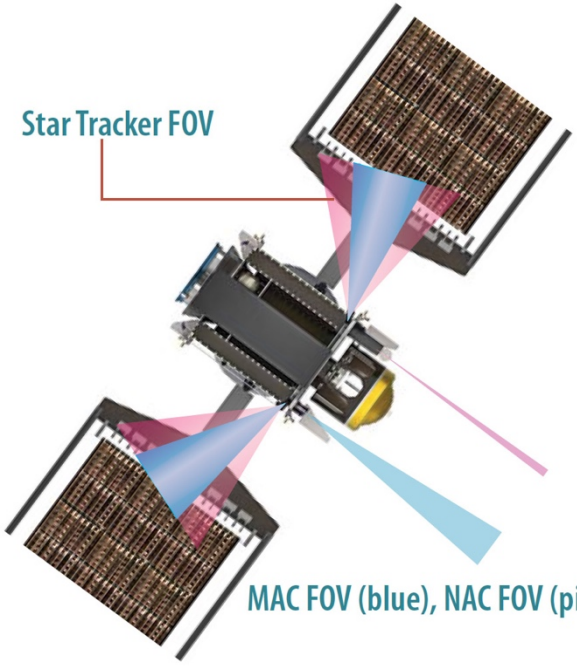
S. Fornasier,[1*] S. Mottola,[2] H. U. Keller,[2,3] M. A. Barucci,[1] B. Davidsson,[4] C. Feller,[1] J. D. P. Deshapriya,[1] H. Sierks,[5] C. Barbieri,[6] P. L. Lamy,[7] R. Rodrigo,[8,9] D. Koschny,[10] H. Rickman,[11,12] M. A'Hearn,[13] J. Agarwal,[5] J.-L. Bertaux,[14] I. Bertini,[6] S. Besse,[15] G. Cremonese,[16] V. Da Deppo,[17] S. Debei,[18] M. De Cecco,[19] J. Deller,[5] M. R. El-Maarry,[20] M. Fulle,[21] O. Groussin,[22] P. J. Gutierrez,[8] C. Güttler,[5] M. Hofmann,[5] S. F. Hviid,[2] W.-H. Ip,[23,24] L. Jorda,[22] J. Knollenberg,[2] G. Kovacs,[5,25] R. Kramm,[5] E. Kührt,[2] M. Küppers,[15] M. L. Lara,[8] M. Lazzarin,[6] J. J. Lopez Moreno,[8] F. Marzari,[6] M. Massironi,[26,27] G. Naletto,[28,27,17] N. Oklay,[5] M. Pajola,[29,27] A. Pommerol,[20] F. Preusker,[2] F. Scholten,[2] X. Shi,[5] N. Thomas,[20] I. Toth,[30] C. Tubiana,[5] J.-B. Vincent[5]

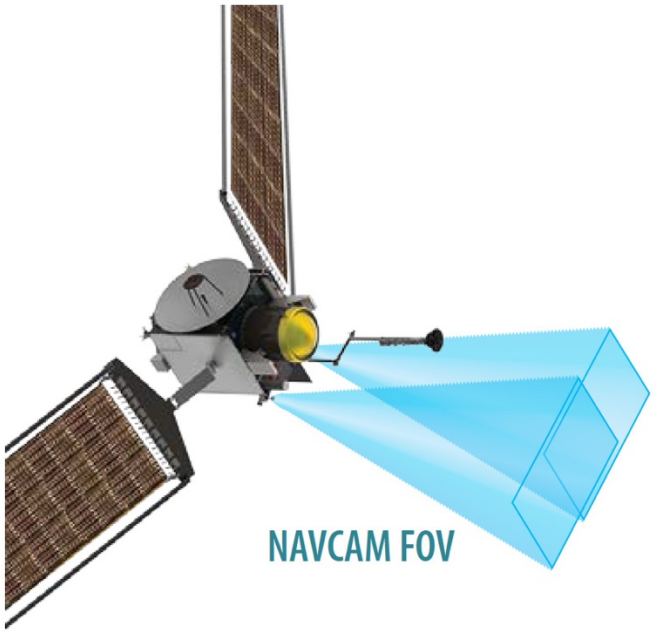


"The increase in water-ice visibility is observed on the whole surface, indicating that the composition in terms of dust-to-ice ratio must be similar at large scales all over the nucleus. This means that even the smooth areas commonly thought to be covered with material that fell back on the surface (18) must be water-ice rich."

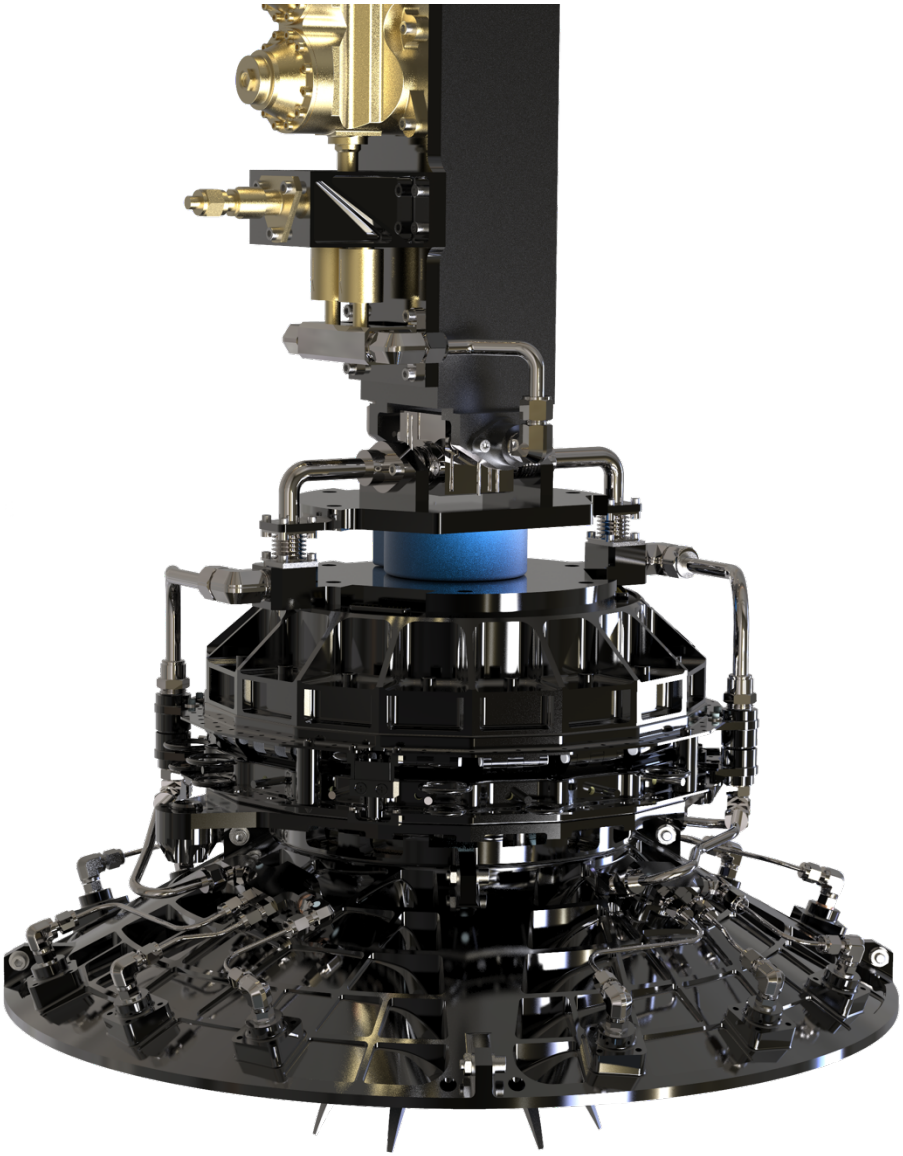
Camera Suite

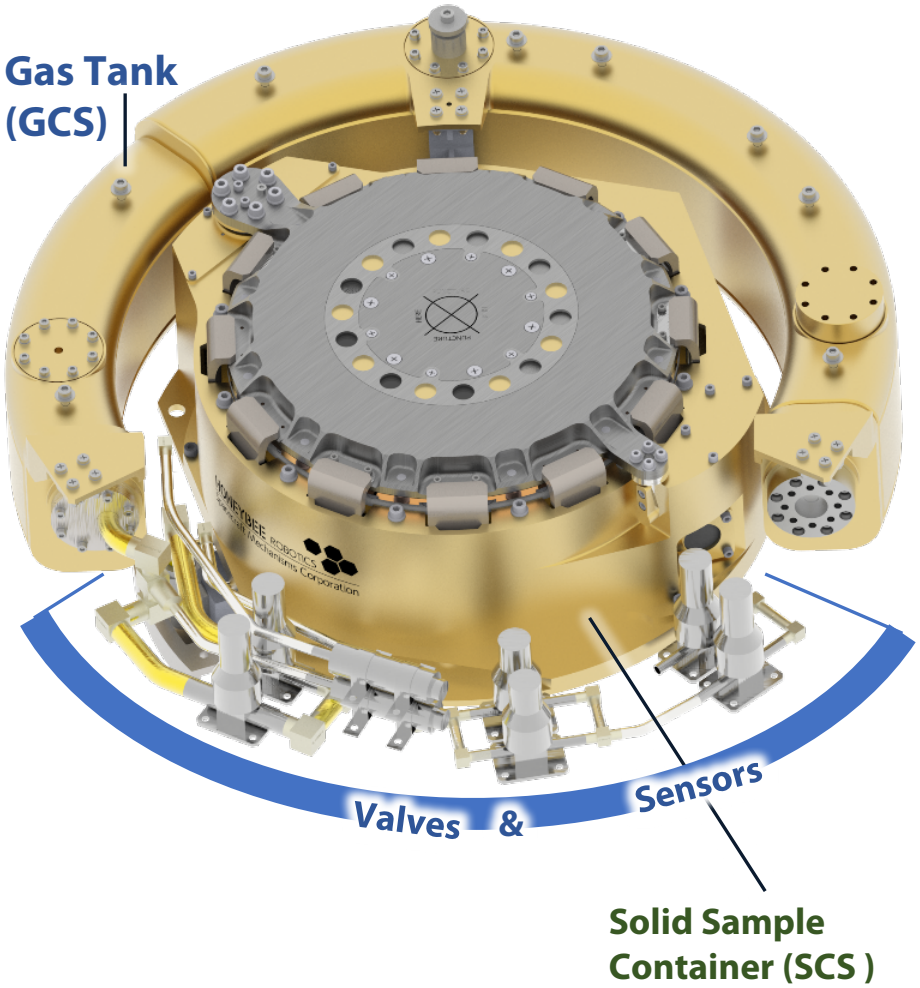
NAC	MAC	TAGCAM	NAVCAM	CANCAM
				
				



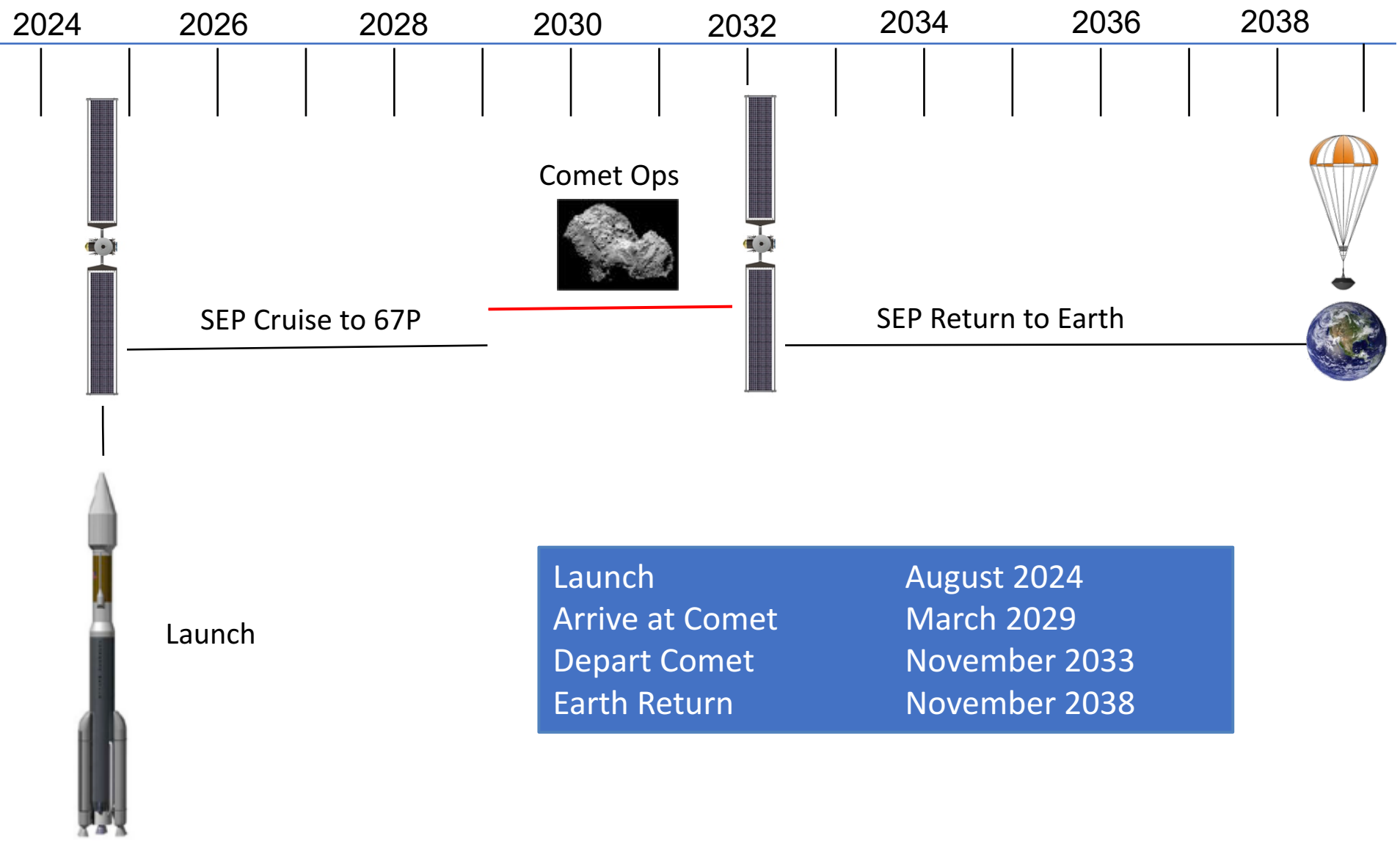


Sample Acquisition & Containment Sys.



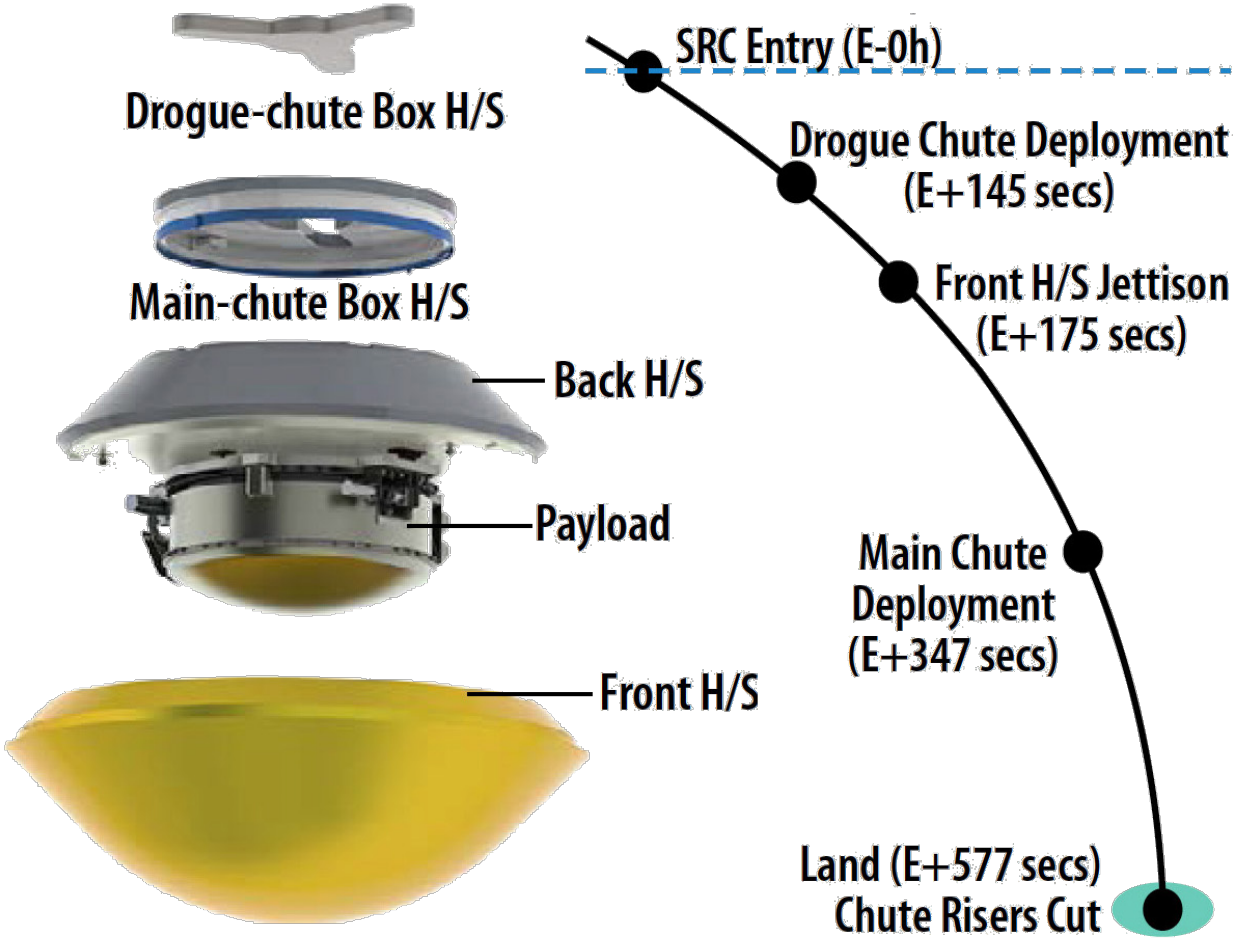


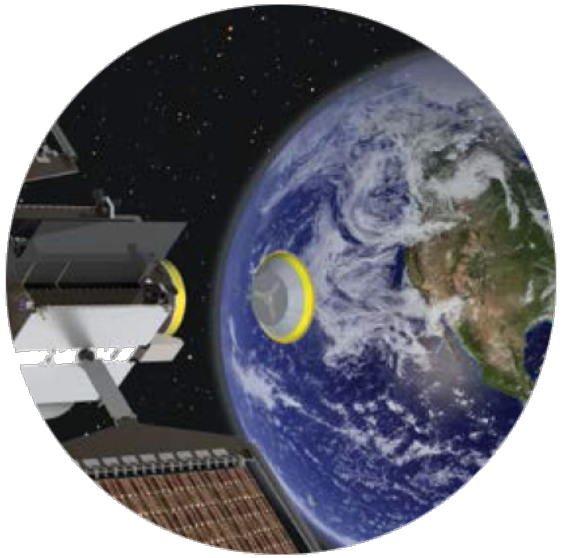
Mission Timeline



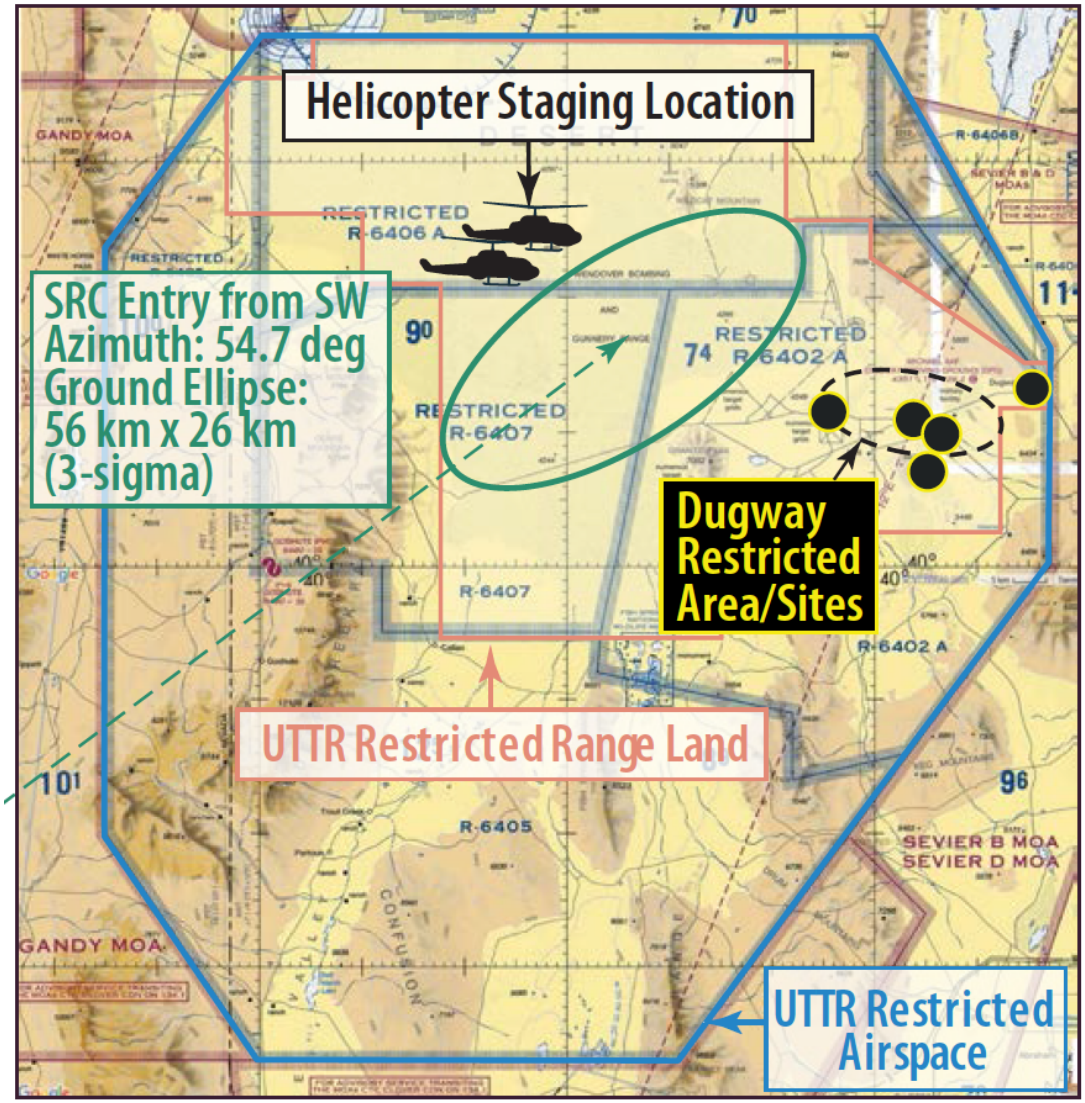
Launch	August 2024
Arrive at Comet	March 2029
Depart Comet	November 2033
Earth Return	November 2038

Sample Return Capsule



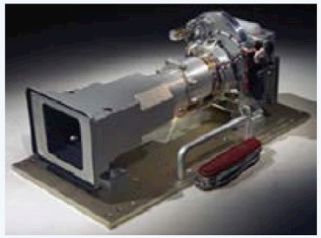
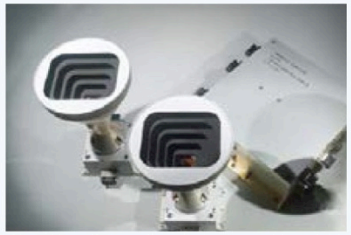
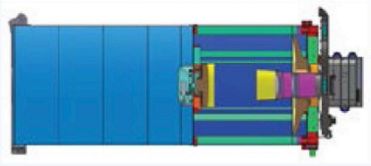
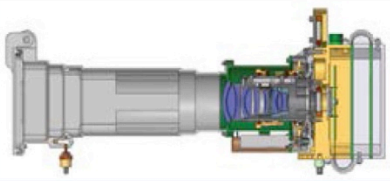
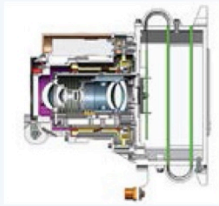
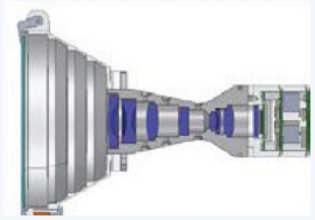
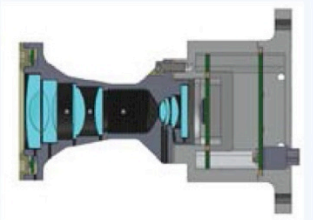


SRC Recovery

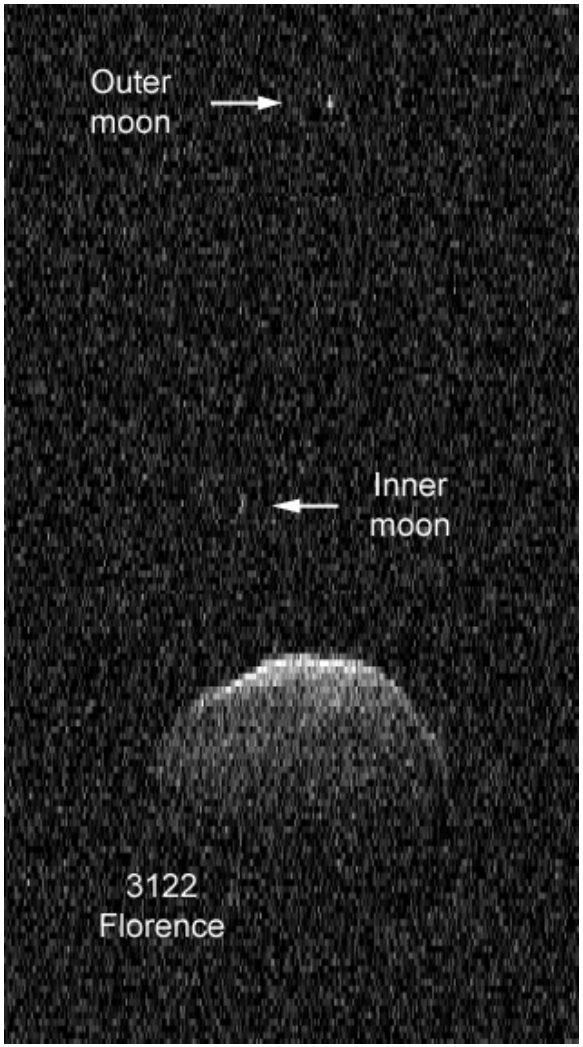


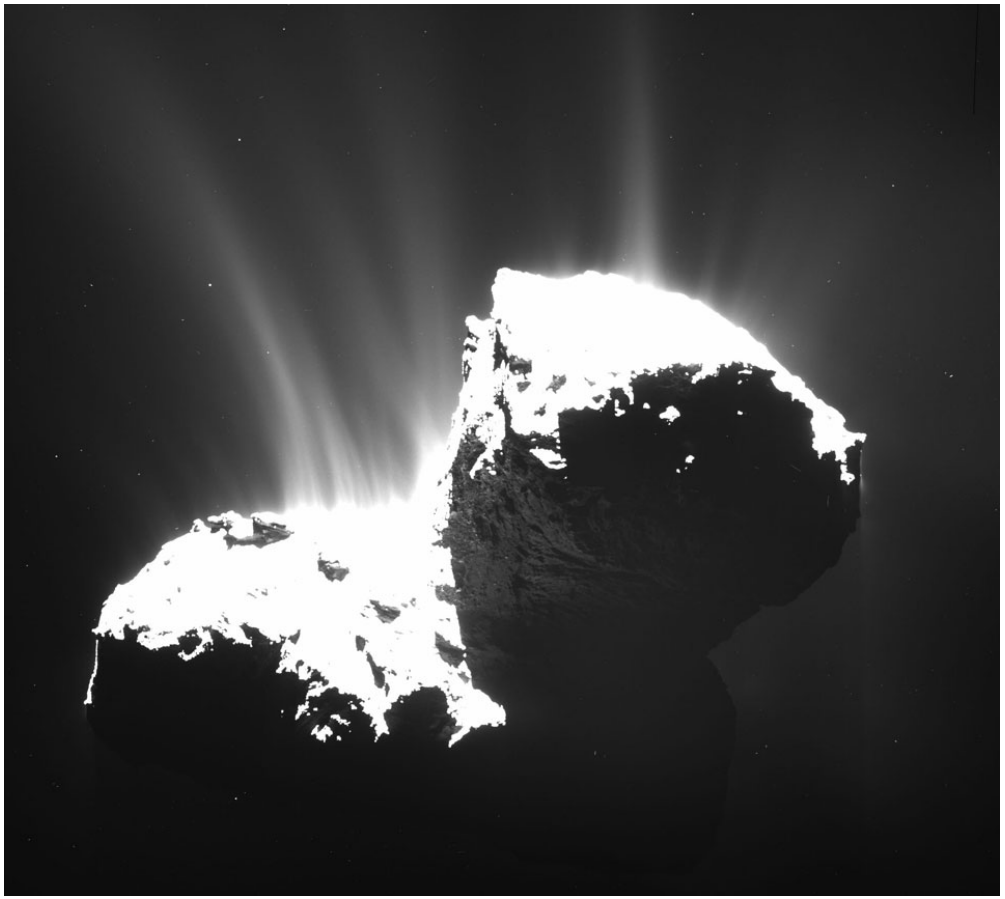
CAESAR Camera Suite objectives

- Determine environmental hazards to the Spacecraft
- Spacecraft Navigation
- Support selection of the TAG site
- Document the TAG event & sample
- Studying the provenance of the site

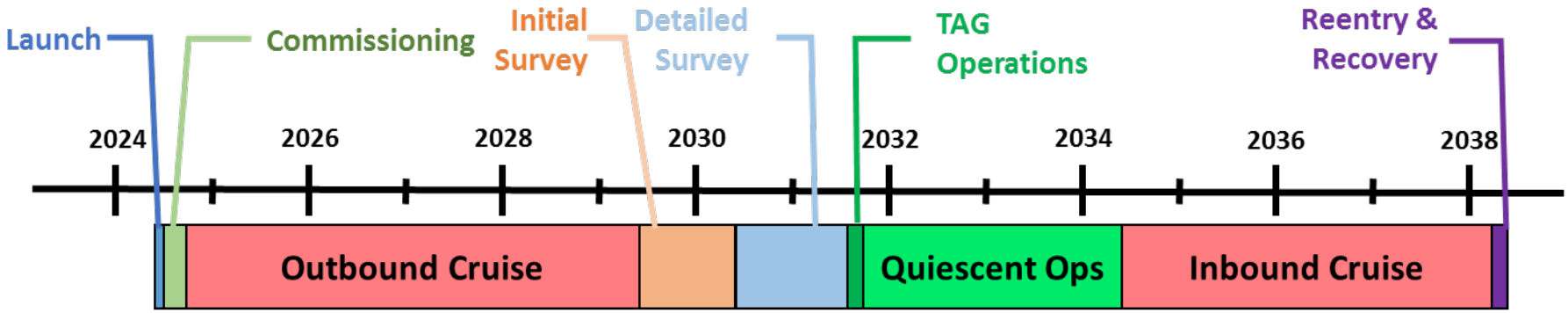
NAC	MAC	TAGCAM	NAVCAM	CANCAM
				
				

S/C environmental hazards

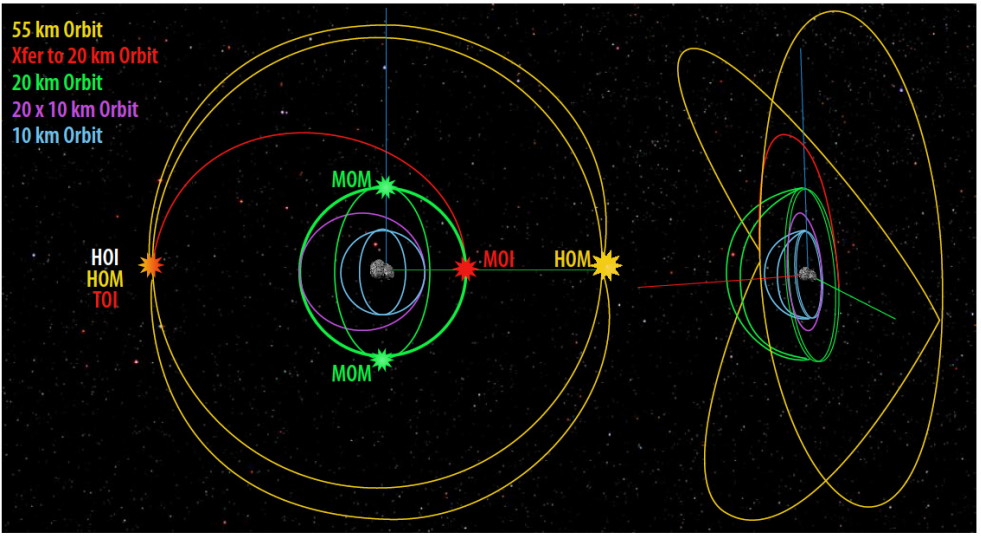




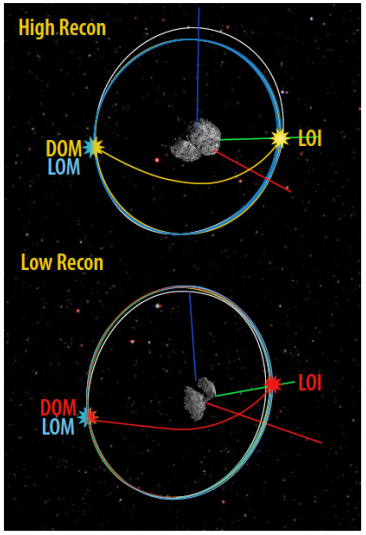
Spacecraft Navigation



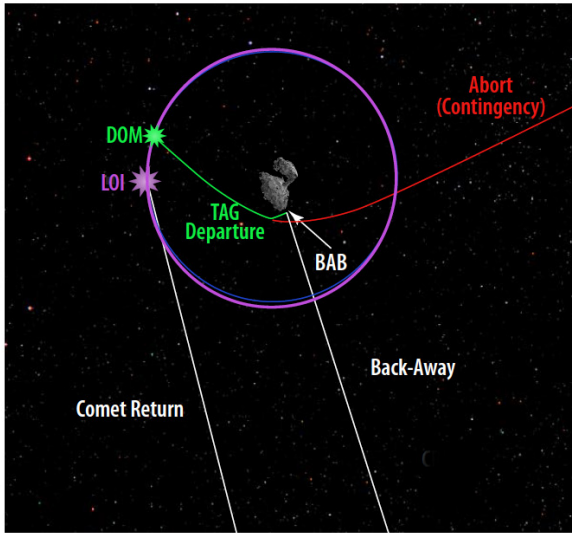
Initial Survey



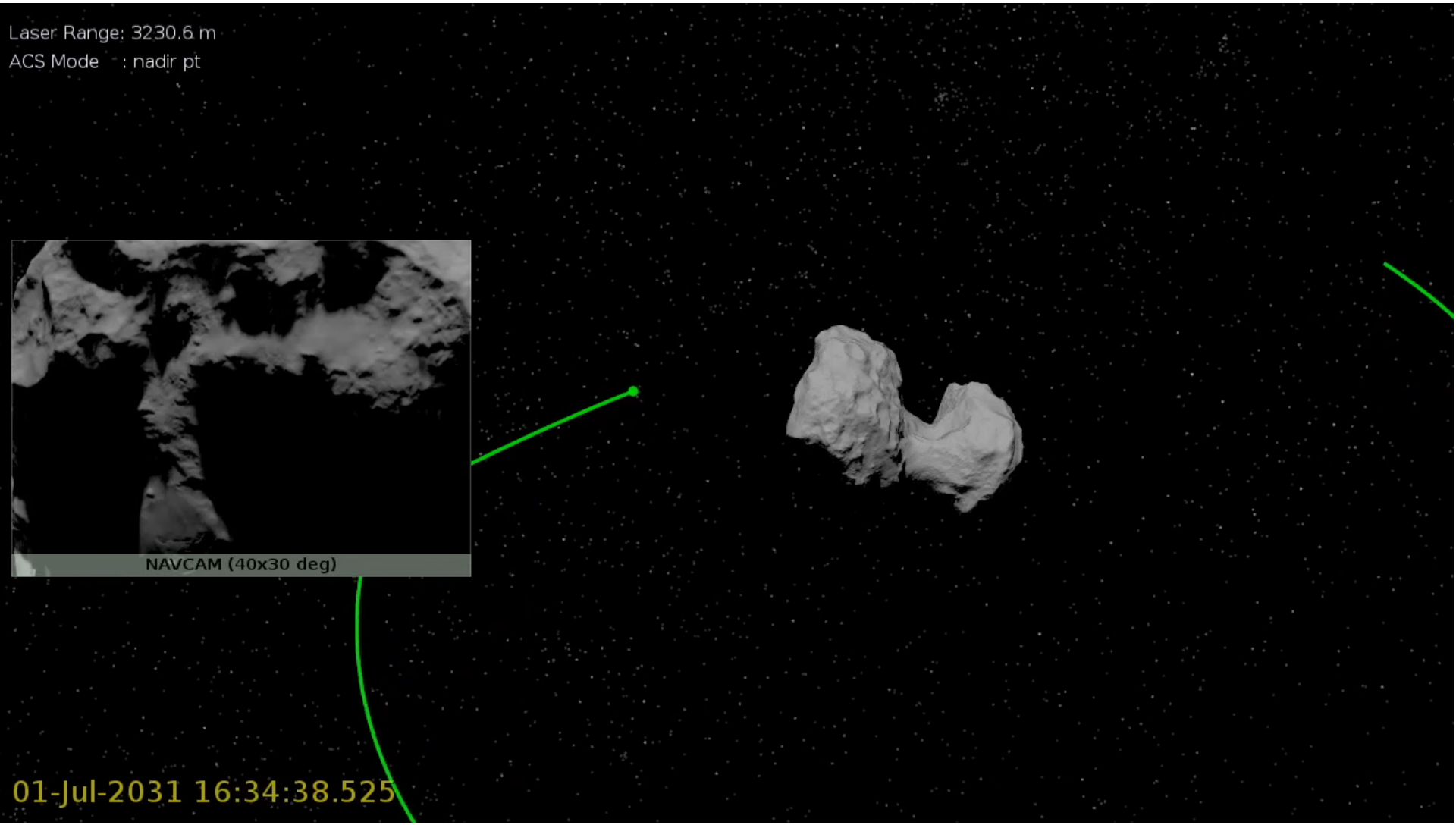
Detailed Survey



TAG Operations



TAG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NAVCAM (40x30 deg)
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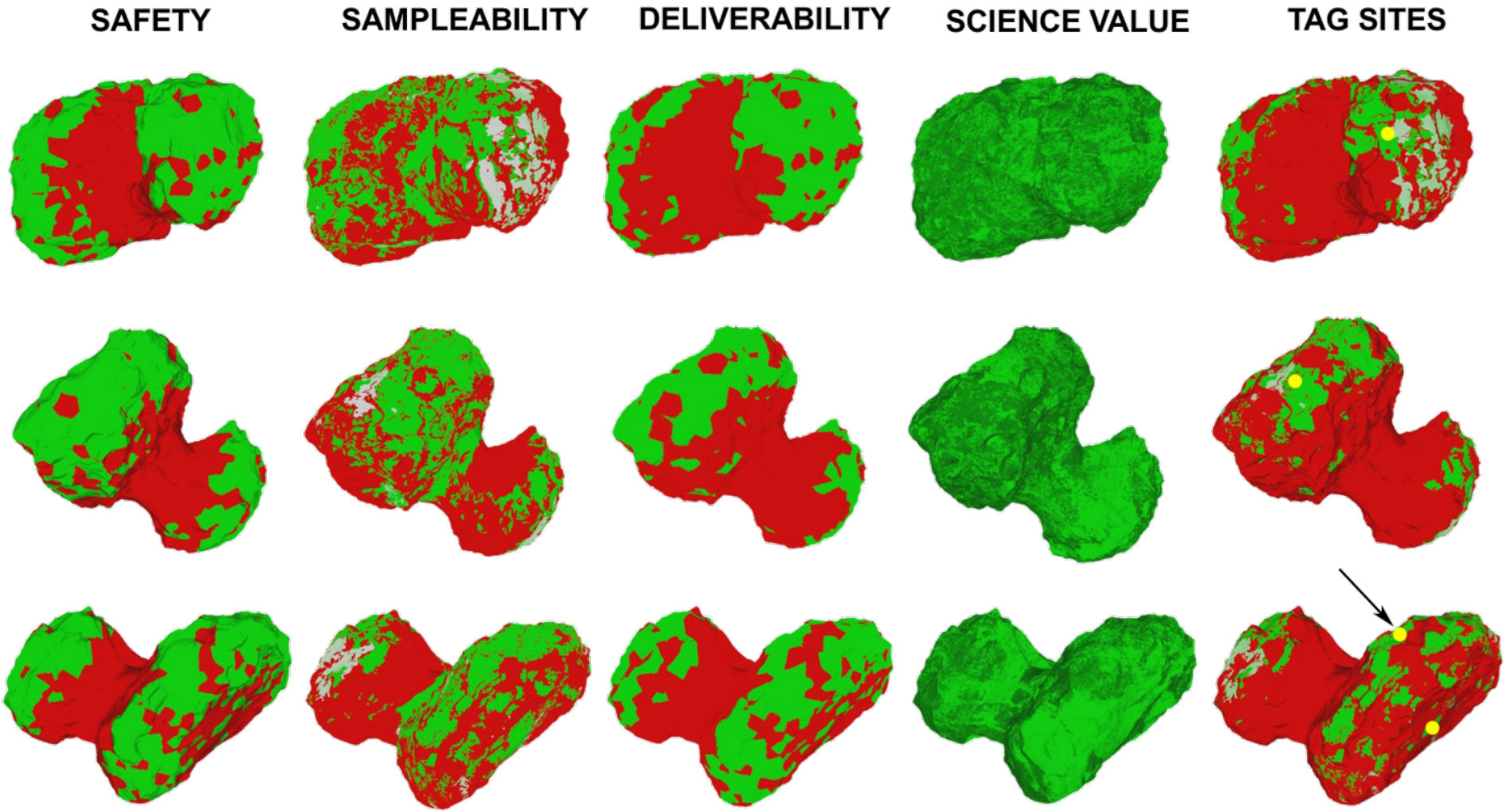
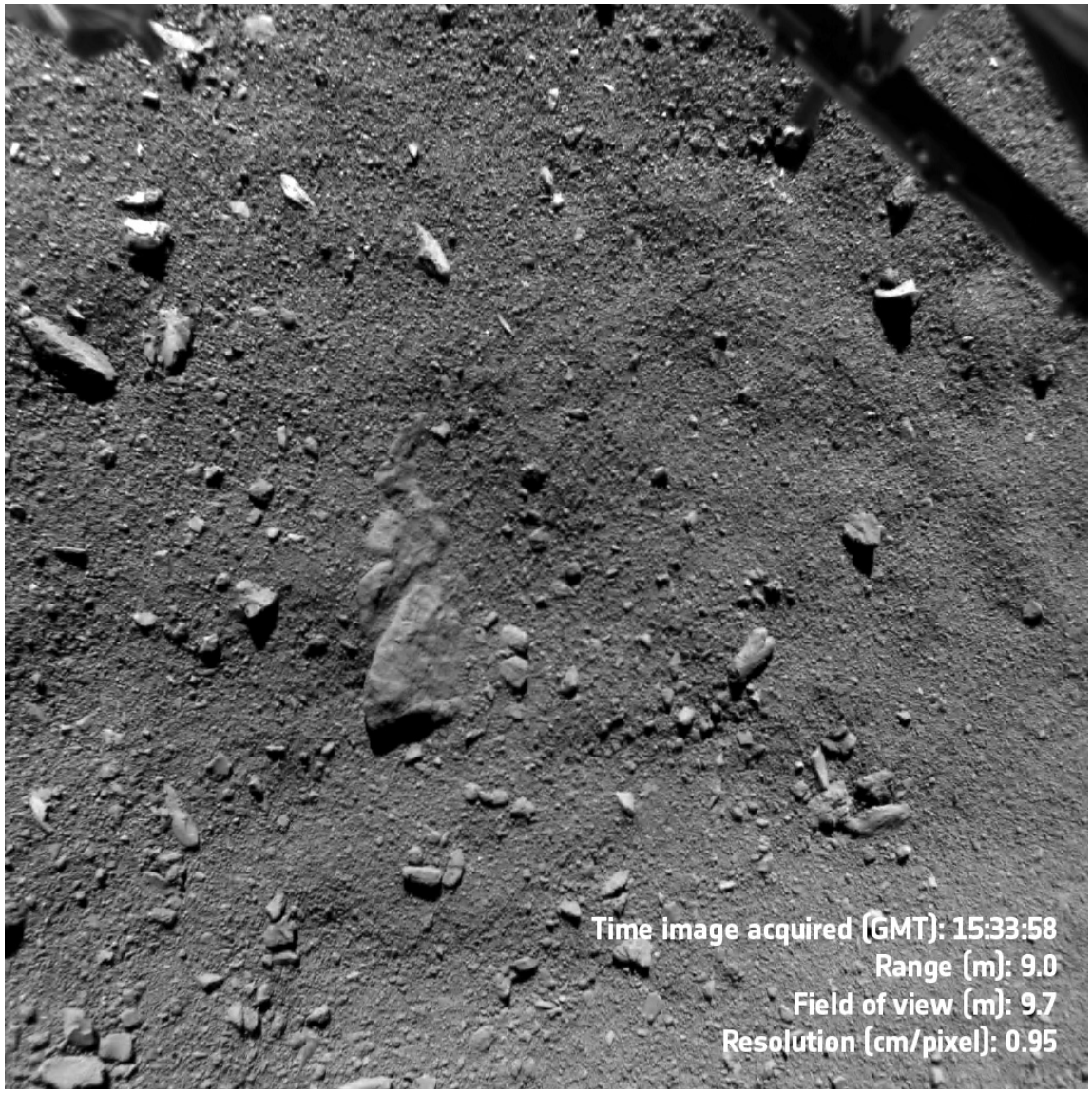
TAG Site Selection



Sampleability



Ice Distribution on 67P

Rosetta's comet 67P/Churyumov-Gerasimenko sheds its dusty mantle to reveal its icy nature

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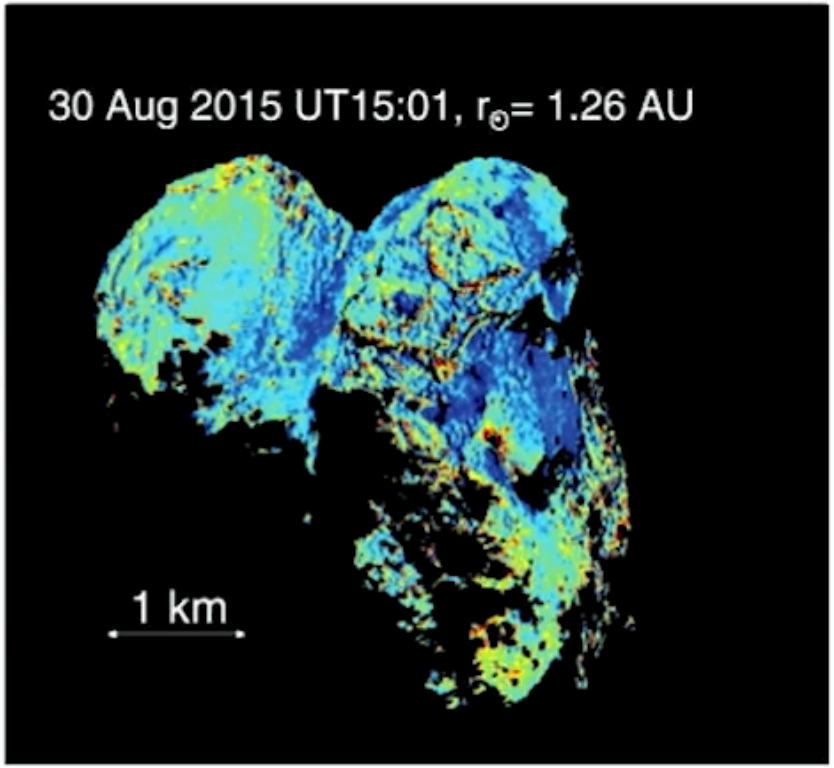

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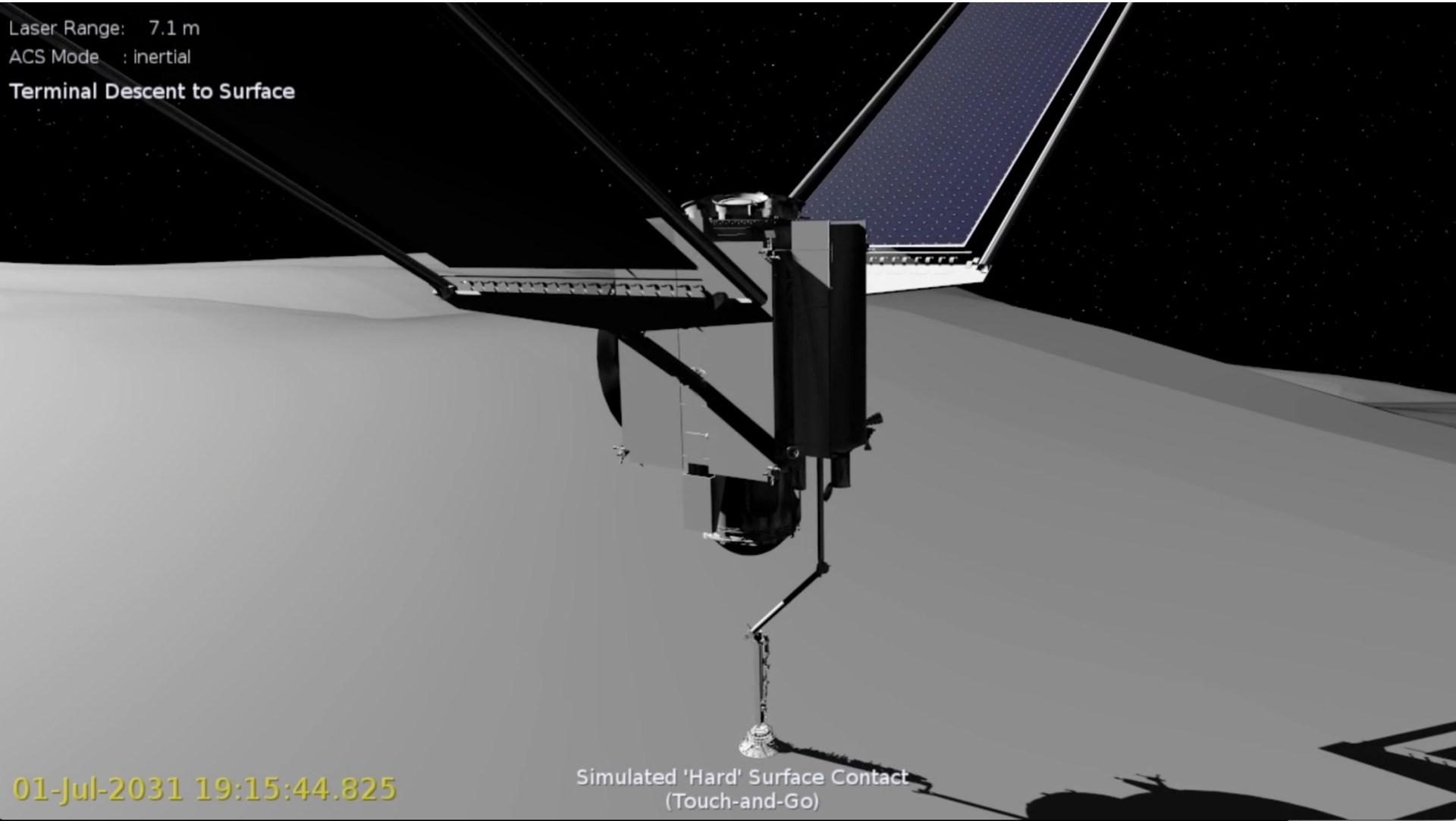
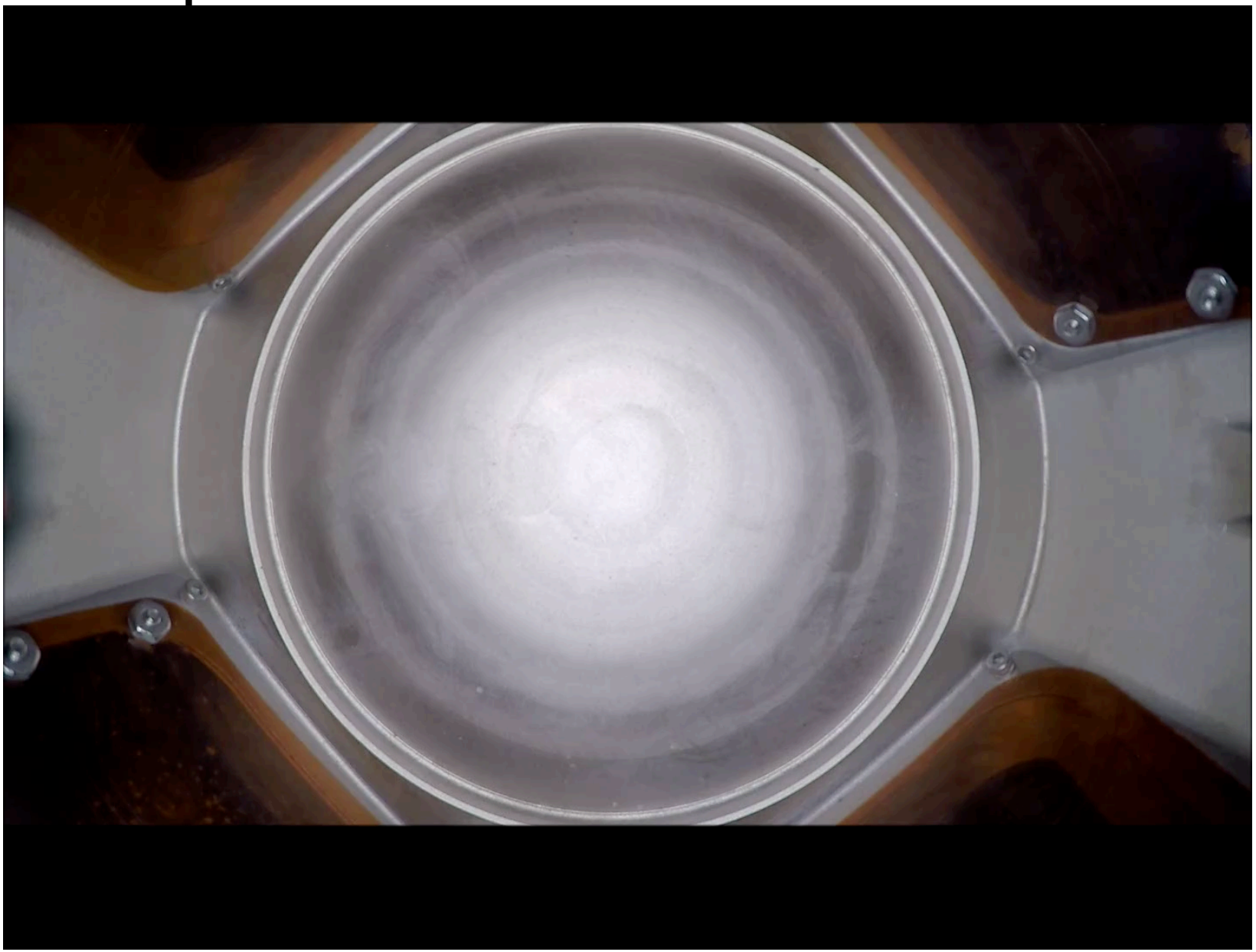
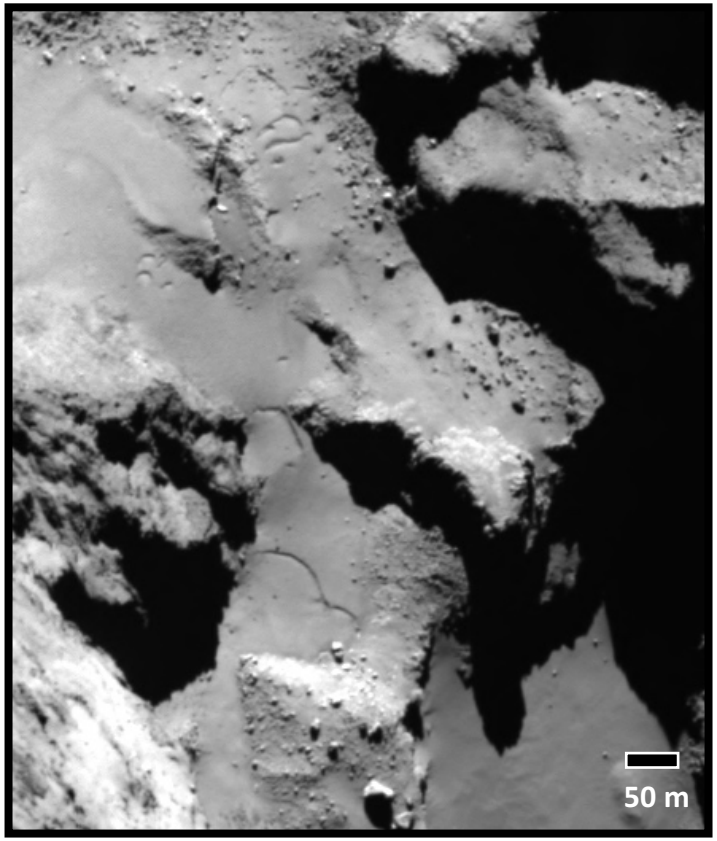
TAG Event documentation

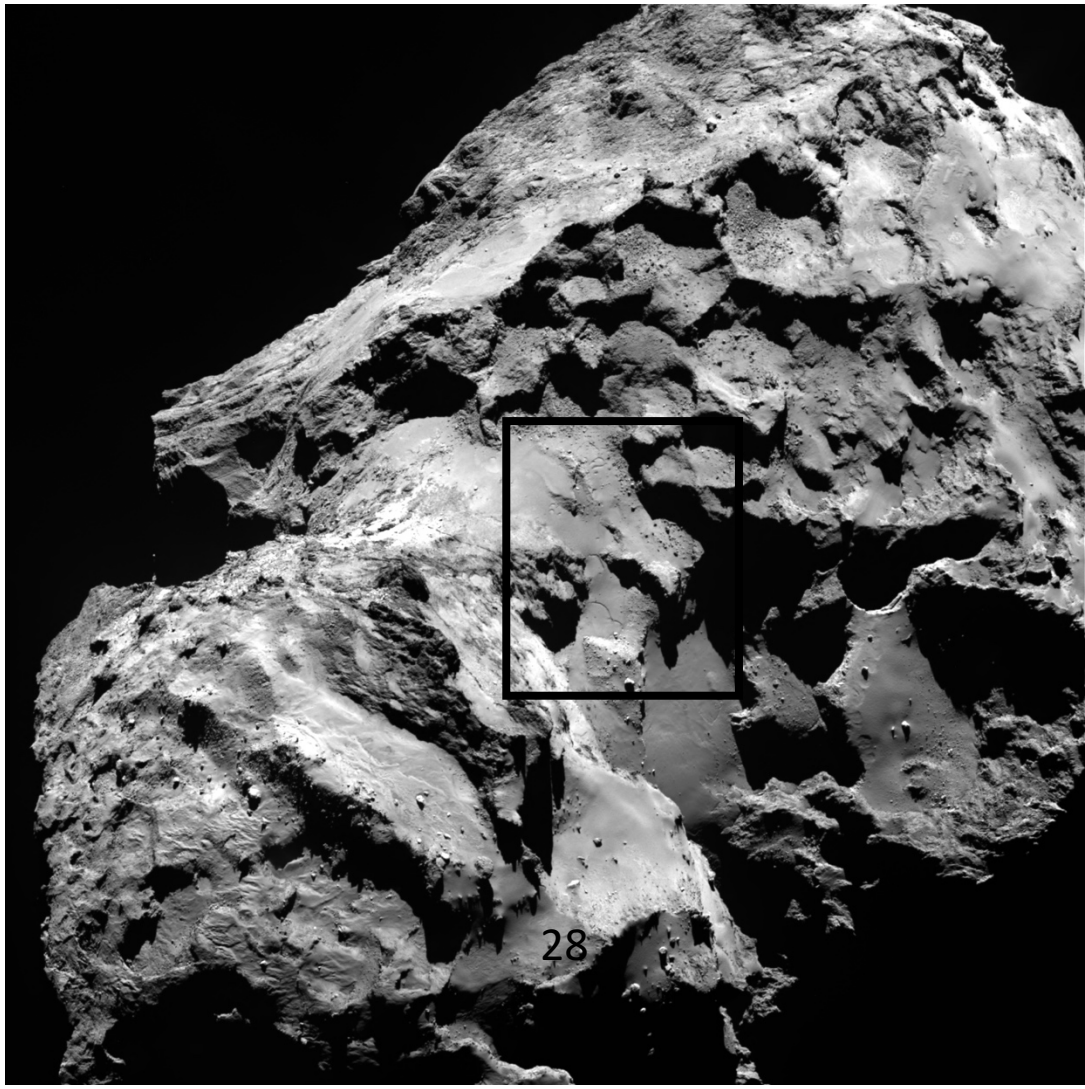


Sample collection documentation



Sample provenance





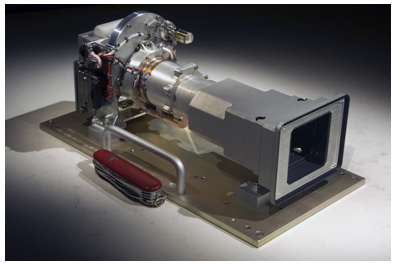
CAESAR Camera Suite built by MSSS

2 Wide-FOV Navigation Cameras (NAVCAMS)
OpNav & autonomous approach / TAG

ECAM50 (OSIRIS-Rex TAGCAMS)

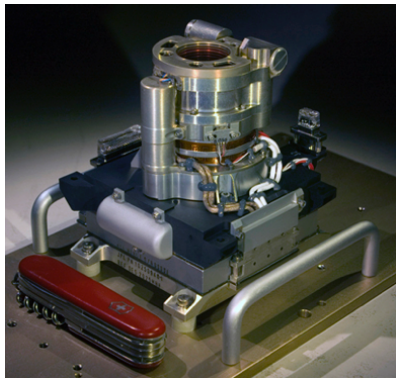
1 Mid-angle Camera (MAC), inc. color filters
site identification /characterization & navigation

Mars Science Laboratory Mastcam M100



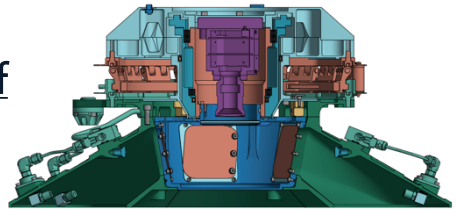
1 Mid-FOV Arm-Mounted TAG Camera (TAGCAM) for documenting TAG event

Mars Science Laboratory MAHLI instrument



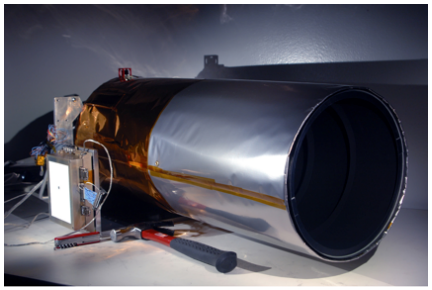
1 Wide-FOV Sample Canister camera (CANCAM)
video documentation of sample acquisition

ECAM50 (OSIRIS-Rex TAGCAMS)



Narrow Angle Camera (NAC),
site identification and characterization & navigation

Lunar Reconnaissance Orbiter Narrow Angle Camera



The CAESAR Team