# OCCATOR


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## Observation of Ceres Components and Analysis of seismic and Tidal processes, Origin in the solar system and Roots of life

Ceres, a mysterious dwarf planet which will reveal a lot of its secrets. As succession of the Dawn mission, the OCCATOR mission is designed. To determine the origin and formation of Ceres, to understand the dynamics and the building blocks of the early solar system and to learn more about the origin of life, an orbiter with lander and two mini-rovers will be send to Ceres. Ultimately, the presence of hydrocarbons, water and salt depositions on Ceres can contribute to the understanding of early life and how it may have formed in the solar system. Additionally, Ceres is more accessible than the outer solar system planets and moons.

### Objectives

The primary objectives:

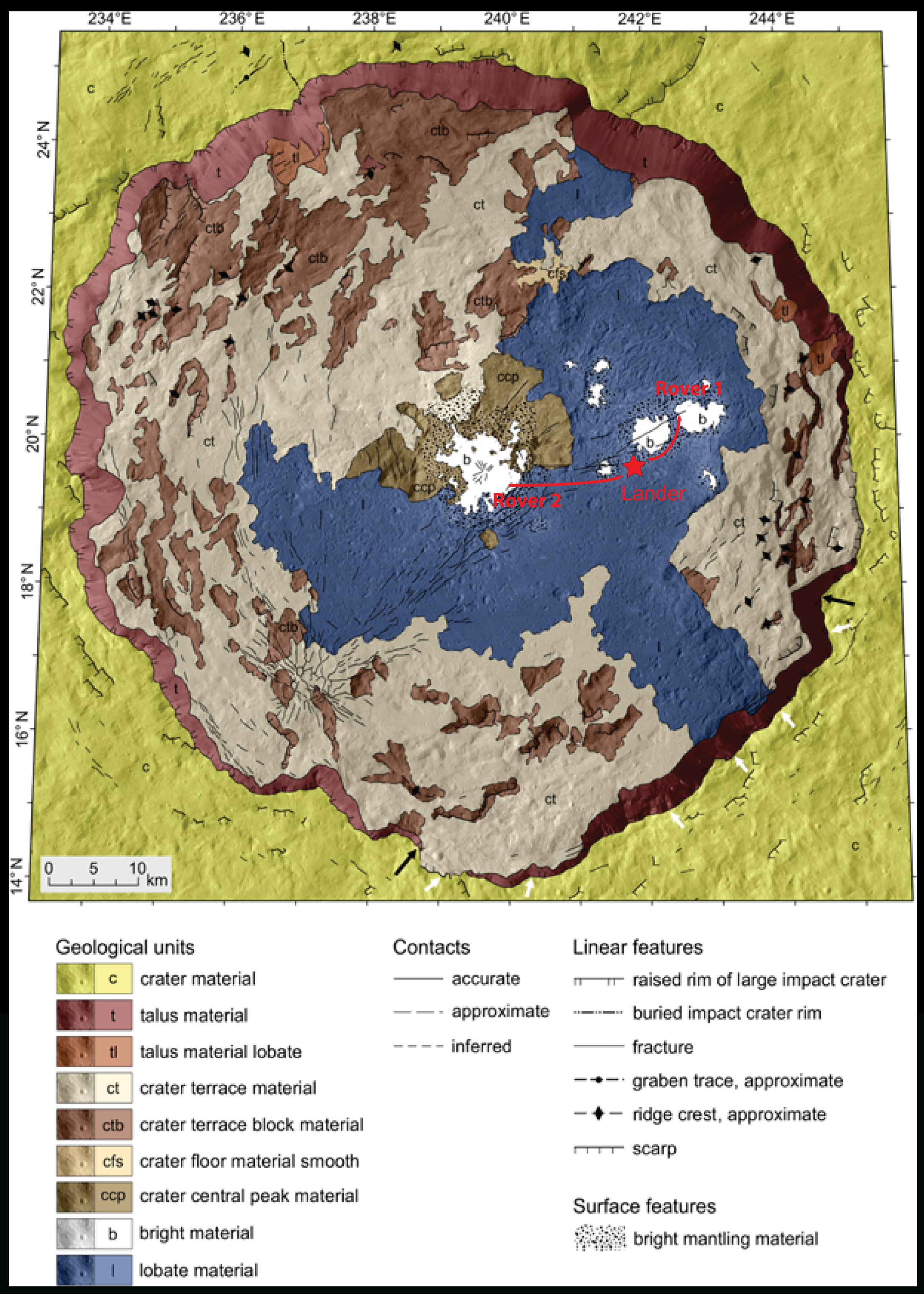
- Identify the architecture of the interior of Ceres
- Determine the presence and composition of subsurface liquids on Ceres
- Search for possibilities of life on Ceres

The secondary objectives:

- Investigate the formation of carbonates, salts and ammoniated phyllosilicates on the surface of Ceres
- Identify ongoing geological activities regarding ice deposits from the subsurface
- Technological improvement of lander and instruments for Ceres surface conditions

### Mission design

- Orbiter, Lander and two mini-rovers
- Landing inside the crater (19.8 °N, 239.3 °E)
- Observing fracture sets and recent geological activity [1]
- Observing the subsurface for fluids
- Determine the chemical composition of the bright spots
- Determine the process generating the bright spots, for instance due to cryomagmatism or post-impact hydrothermal activity [2,3,4]




*Map of Occator crater [5] with landingspot (red star) and routes of the rovers (red lines)*

### Instruments [6,7,8]

Orbiter

- Gamma Ray Spectrometer (GRS)
- Microwave Instrument Ceres Orbiter (MICO)
- Visible and Infrared Thermal Imaging Spectrometer (VIRTIS)
- Framing Camera (FC)
- Communication Disk (COD)

Lander

- Surface Stereo Imager (SSI)
- Robotic Arm (RA) and Camera (RAC)
- Thermal and Evolved Gas Analyzer (TEGA)
- Ceres Lander Imaging Technology (C-LIT)
- Heat Flow and Physical Properties Probe ($HP^3$)
- Seismic Experiment for Interior Structure (SEIS)

Mini rovers [9]

- Additive System of Photographic Exposure (APXS)
- Observational Camera (OC)

### Costs

| | |
|---|---|
| Rocket: | $ 65.000.000 |
| Satellite: | $ 475.000.000 |
| Lander + rovers: | $ 450.000.000 |
| Total costs: | $ 990.000.000 |

### Proposed schedule

| | |
|---|---|
| Construction | - 2019 – 2021 |
| Testing | - 2021 – 2027 |
| Launch | - 2027 |
| Mars gravity assist | - 2029 |
| Ceres arrival | - 2031 |


[1] D.L. Buczkowski et al., (2017), The geology of the occator quadrangle of dwarf planet Ceres: Floor-fractured craters and other geomorphic evidence of cryomagmatism. Icarus, V. 316.
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[4] T.J. Bowling et al., (2016), Impact induced heating of Occator crater on asteroid 1 Ceres. Lunar and Planetary Science Conference, V. 47.
[5] A. Nathues et al., (2017), Evolution of Occator Crator on (1) Ceres. The Astronomical Journal, V. 153.
[6] http://www.esa.int/Our_Activities/Space_Science/Rosetta/The_Rosetta_lander, consulted on 05-12-2018.
[7] http://phoenix.lpl.arizona.edu/science05.php, consulted on 05-12-2018.
[8] https://mars.nasa.gov/insight/spacecraft/instruments/summary/, consulted on 05-12-2018.
[9] http://www.stellarspaceindustries.com/stellar-space-industries