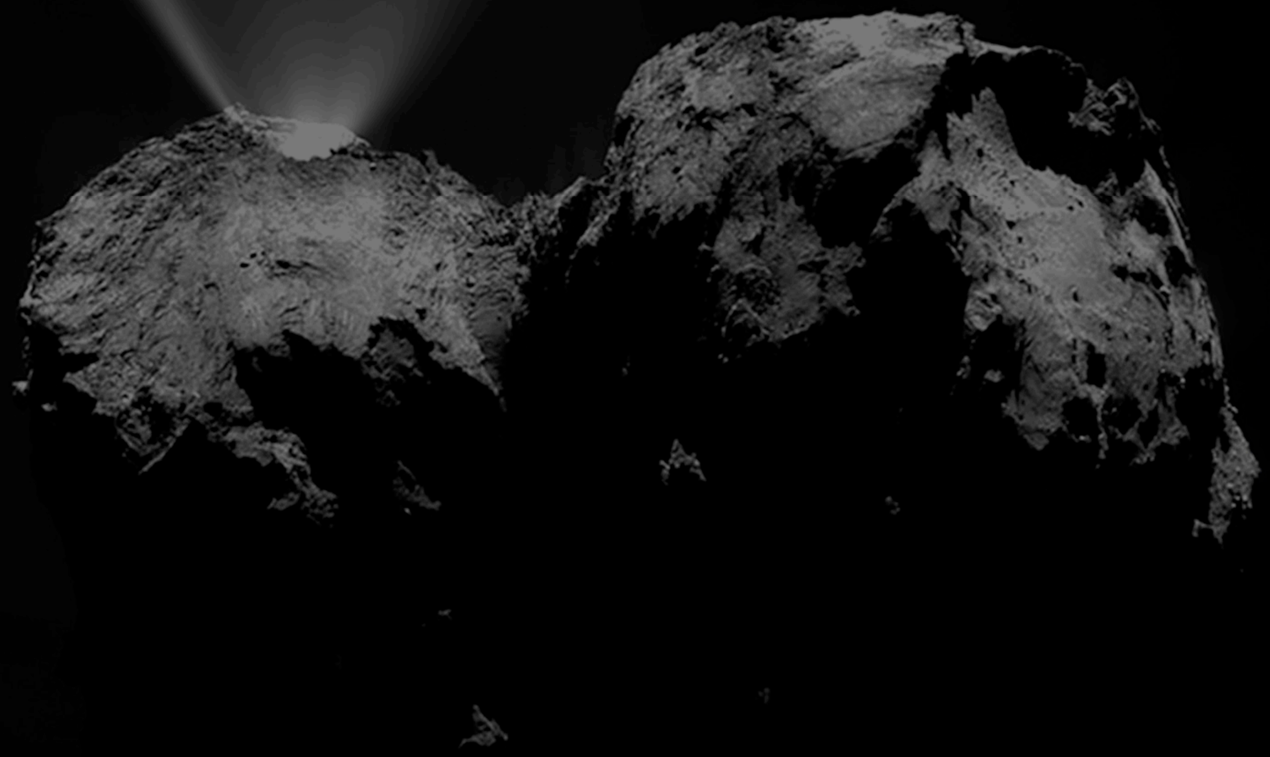
ROSETTA – ERGEBNISSE

ROSETTA – RESULTS



RESULTS TO DATE

The scientists have published a number of observations and conclusions to date.

This is a quick summary of the main results so far.

The analysis of mission data will continue for years to come.

DIE BEDEUTENDSTEN BEOBACHTUNGEN

THE MOST IMPORTANT OBSERVATIONS

APPEARANCE AND SHAPE OF THE COMET

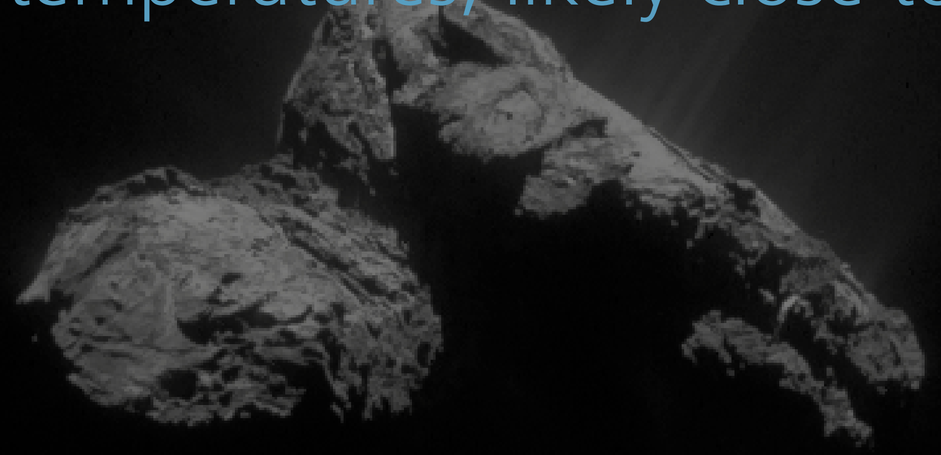
The morphology and material properties are surprisingly diverse.

MORE DUST, LESS ICE

The comet is composed mainly of dust (about 75 weight percent). It has little ice (about 25 weight percent) and is highly porous.

A WIDE VARIETY OF COMPOUNDS

The comet dust contains numerous organic compounds, as well as minerals such as iron sulfides, which formed at high temperatures, likely close to the Sun.



COMPLEX AND INHOMOGENEOUS COMA

The chemical composition of the coma is not homogeneous.

In addition to dust, water and carbon dioxide ice, very volatile and highly complex organic molecules were found.

Among them, an amino acid.

THE SUN STEERS THE ACTIVITY

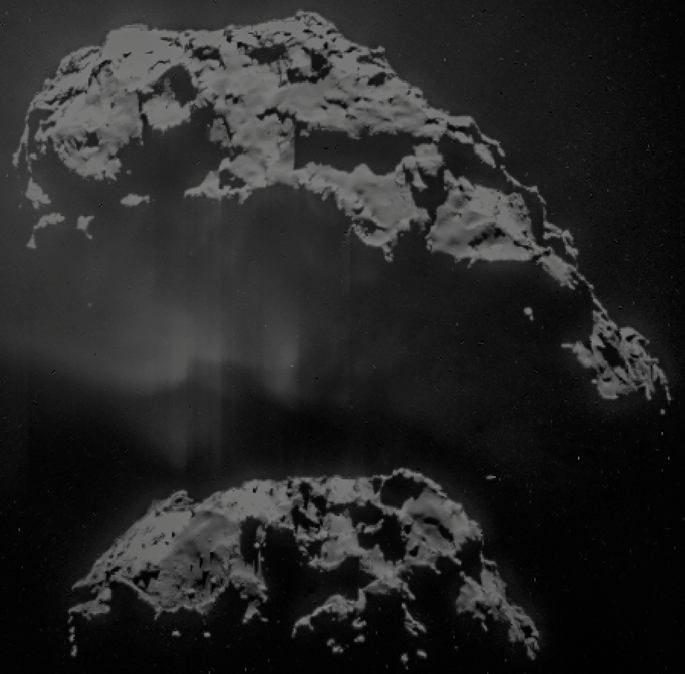
The comet’s activity depends on solar radiation.

It is more or less evenly distributed across the nucleus’ surface and is mostly generated just below the surface.

There are numerous outbursts with increased ejections of dust and gas lasting from a few minutes up to hours.

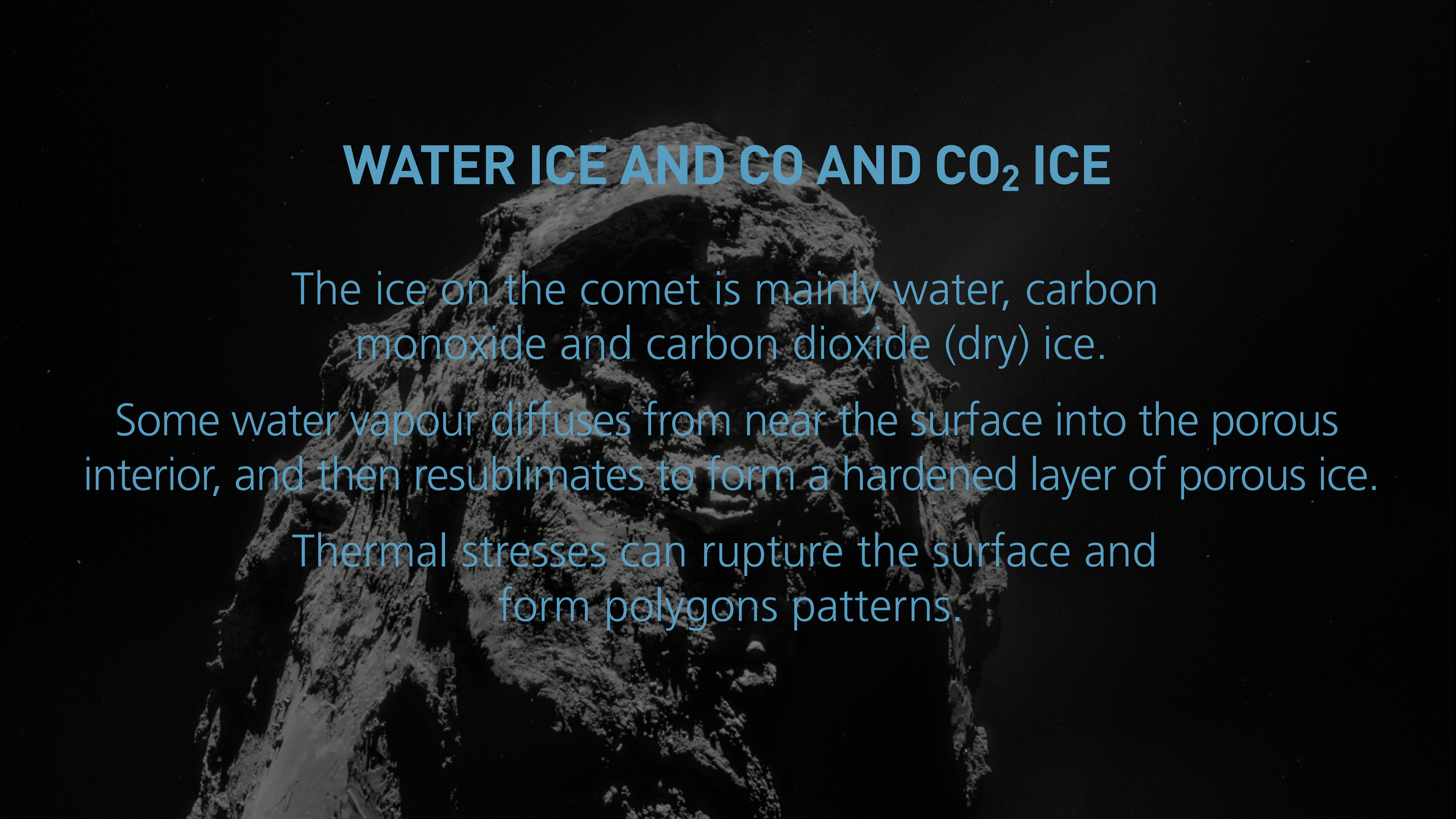
WIE FUNKTIONIEREN KOMETEN?

HOW DO COMETS WORK?



SUBLIMATION OF ICE – THE GAS DRAGS DUST WITH IT

Rosetta has confirmed that the comet's coma and tail are formed by the sublimation (direct transition from solid to gas) of ice and the ejection of dust particles (micrometre to metre size) through gas drag, when the comet is close enough to the Sun.

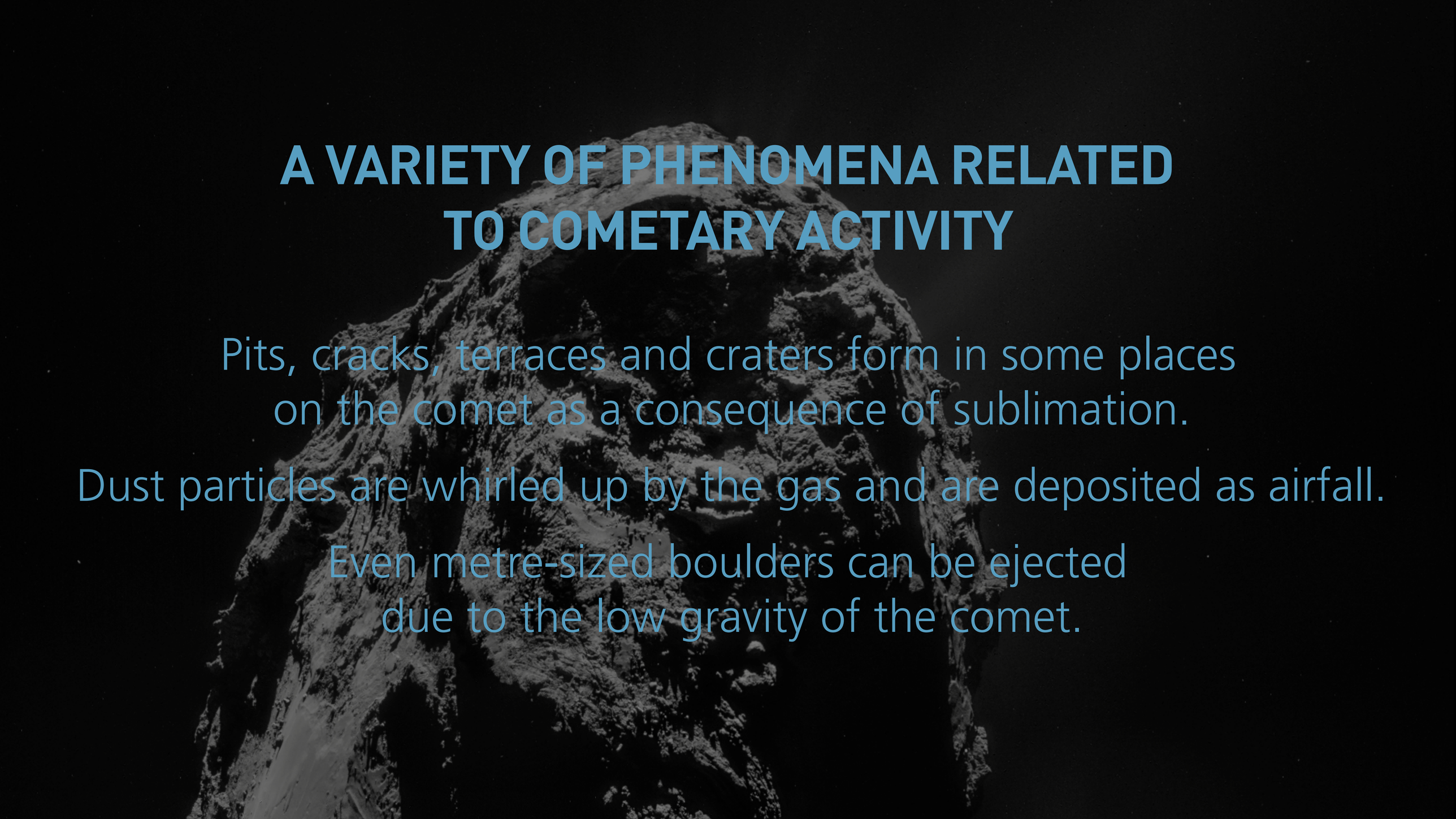


WATER ICE AND CO AND CO_2 ICE

The ice on the comet is mainly water, carbon monoxide and carbon dioxide (dry) ice.

Some water vapour diffuses from near the surface into the porous interior, and then resublimates to form a hardened layer of porous ice.

Thermal stresses can rupture the surface and form polygons patterns.



A VARIETY OF PHENOMENA RELATED TO COMETARY ACTIVITY

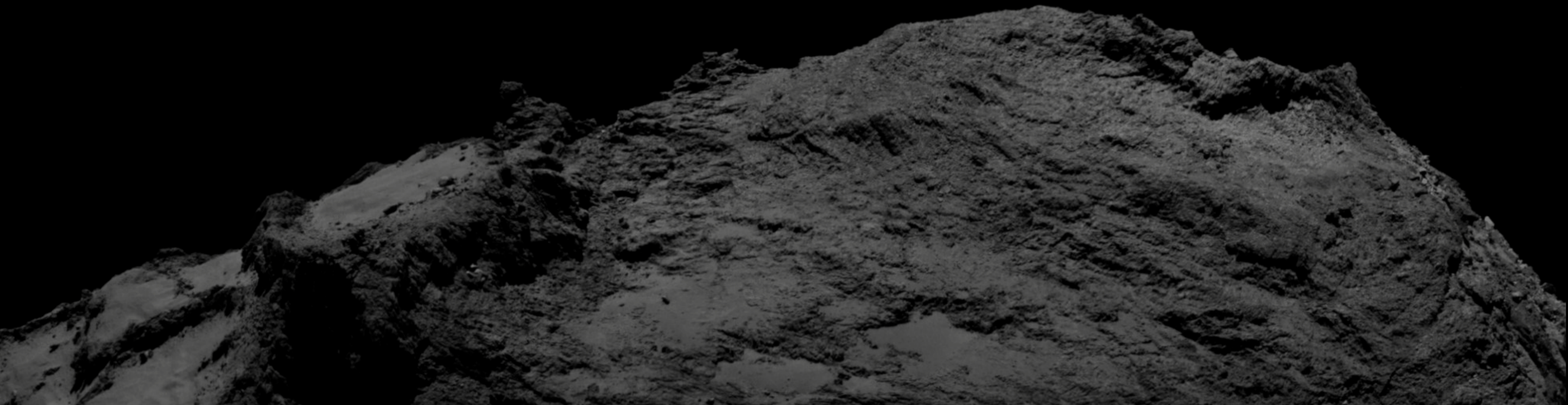
Pits, cracks, terraces and craters form in some places on the comet as a consequence of sublimation.

Dust particles are whirled up by the gas and are deposited as airfall.

Even metre-sized boulders can be ejected due to the low gravity of the comet.

UND WIE IST DAS SONNENSYSTEM ENTSTANDEN?

AND HOW DID THE SOLAR SYSTEM FORM?



PLANETESIMALS WERE FORMED IN THE ACCRETION DISC

The basic idea proposed by Immanuel Kant and Pierre-Simon Laplace remains valid after the Rosetta mission:

A disc formed around the young Sun from a rotating cloud of gas and dust in which planetesimals grew as building blocks for planets.

TESTING AND REFINEMENT OF EXISTING MODELS

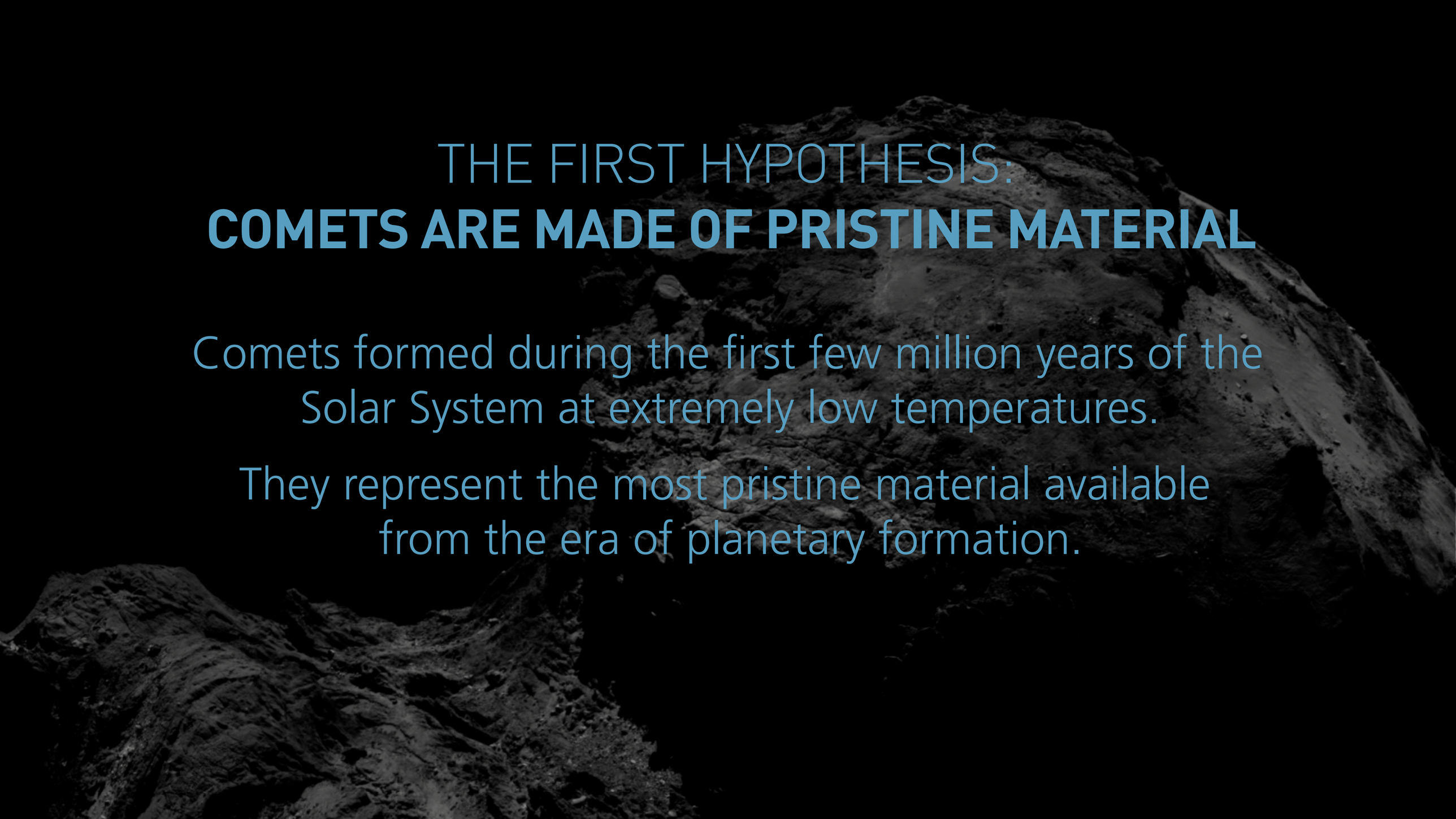
This accretion disc model was developed and refined in recent research.

Some of the underlying ideas of this model are tested and some are even challenged by the results from Rosetta.

Which ones are these?

HYPOTHESEN UND BEOBACHTUNGEN DURCH ROSETTA

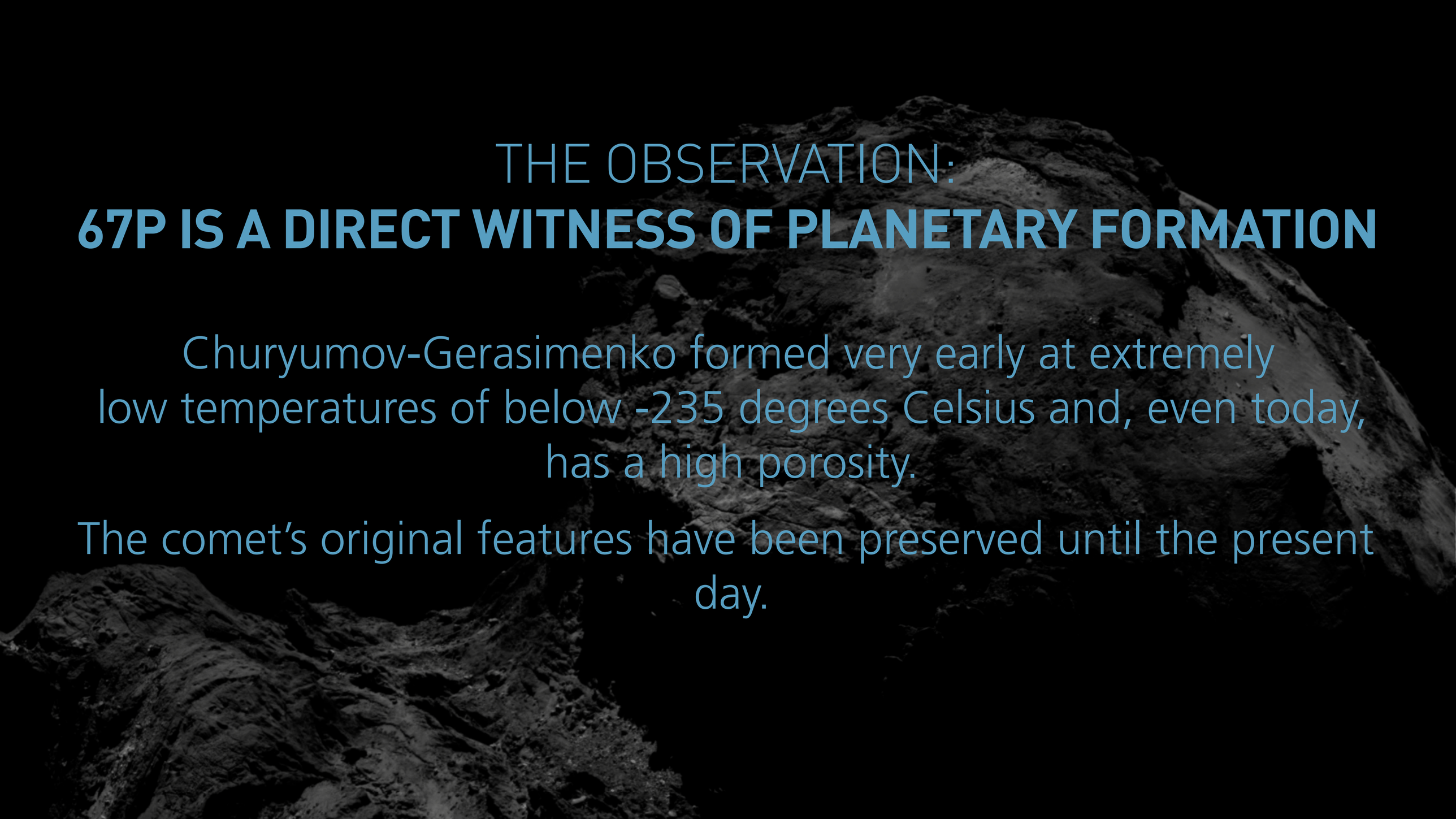
HYPOTHESES AND ROSETTA OBSERVATIONS



THE FIRST HYPOTHESIS:
COMETS ARE MADE OF PRISTINE MATERIAL

Comets formed during the first few million years of the Solar System at extremely low temperatures.

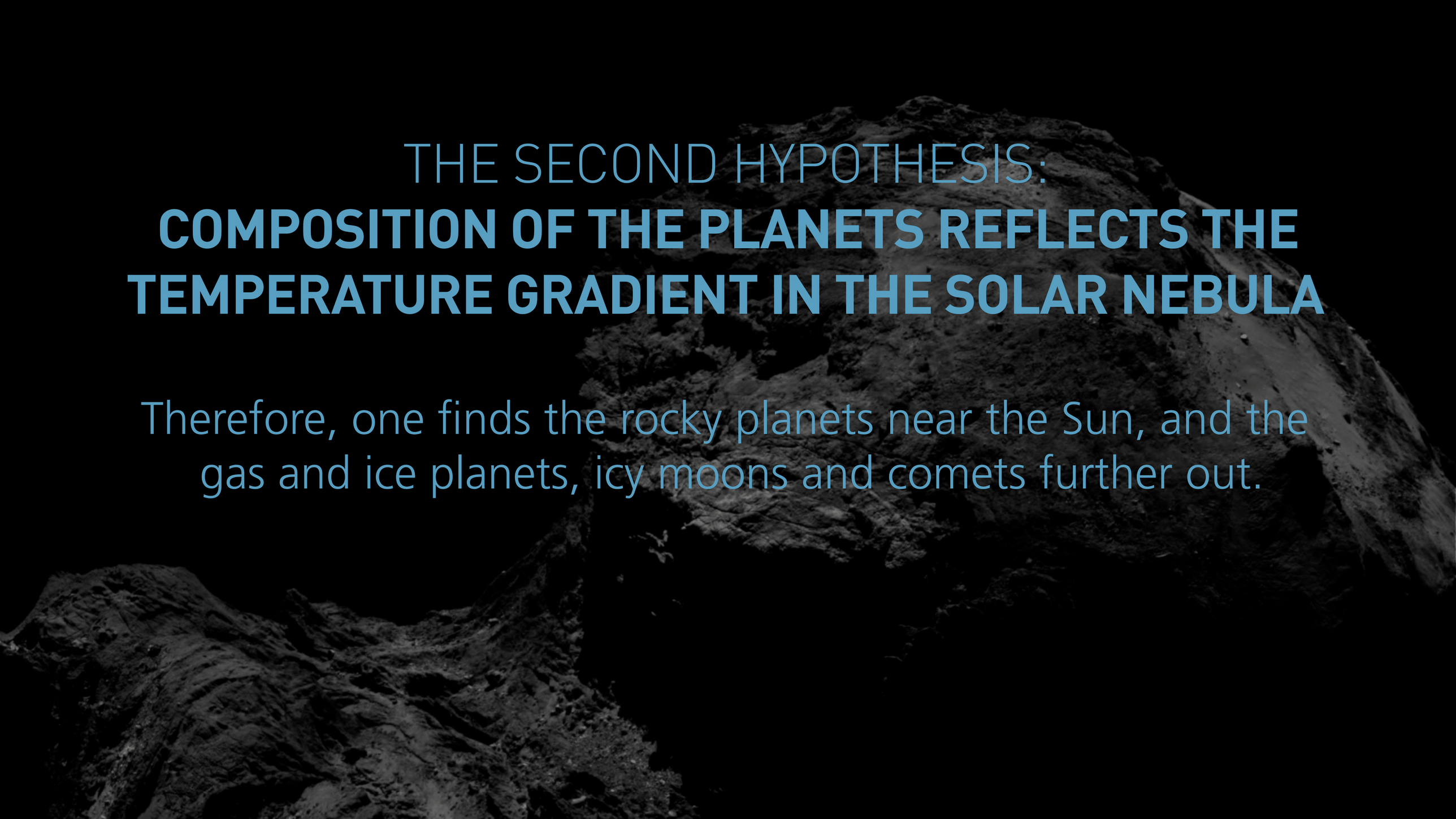
They represent the most pristine material available from the era of planetary formation.



THE OBSERVATION:
67P IS A DIRECT WITNESS OF PLANETARY FORMATION

Churyumov-Gerasimenko formed very early at extremely low temperatures of below -235 degrees Celsius and, even today, has a high porosity.

The comet’s original features have been preserved until the present day.



THE SECOND HYPOTHESIS:
COMPOSITION OF THE PLANETS REFLECTS THE TEMPERATURE GRADIENT IN THE SOLAR NEBULA

Therefore, one finds the rocky planets near the Sun, and the gas and ice planets, icy moons and comets further out.

THE OBSERVATION:
CHEMICAL MIXING IN THE SOLAR NEBULA

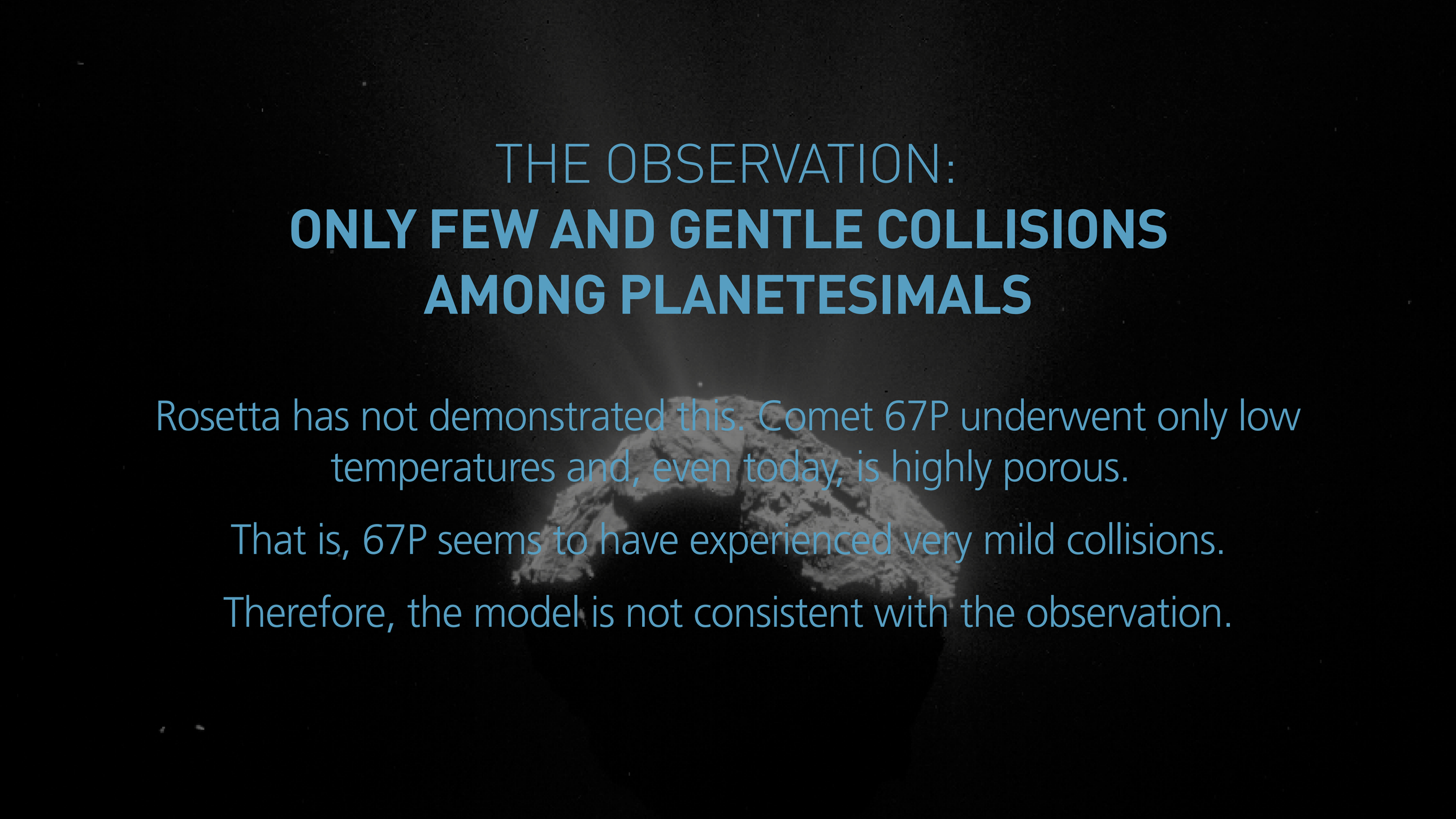
Rosetta has demonstrated that bodies that formed in the outer solar nebula may contain dust and minerals that were formed at relatively high temperatures, likely close to the Sun, but incorporated in colder, more distant regions.

This result suggests significant mixing in the early solar nebula, such that it was more homogeneous than previously thought.

THE THIRD HYPOTHESIS: **COMETS EXPERIENCED STRONG COLLISIONS DURING THEIR EVOLUTION**

Some peculiarities of the Solar System can be explained with a hotly-debated model:

Accordingly, the orbits of the four outer planets changed as a consequence of an orbital resonance, and Uranus and Neptune even switched orbits.This popular idea of the movement of the young giant planets would have led cometesimals to be thrown around, violently colliding with each other.



THE OBSERVATION:
ONLY FEW AND GENTLE COLLISIONS AMONG PLANETESIMALS

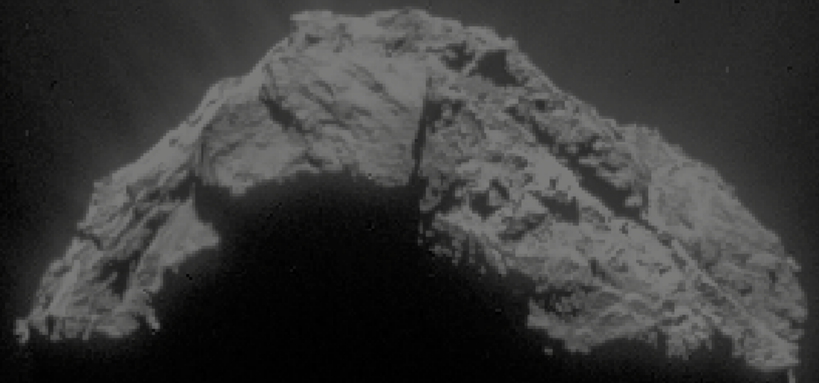
Rosetta has not demonstrated this. Comet 67P underwent only low temperatures and, even today, is highly porous.

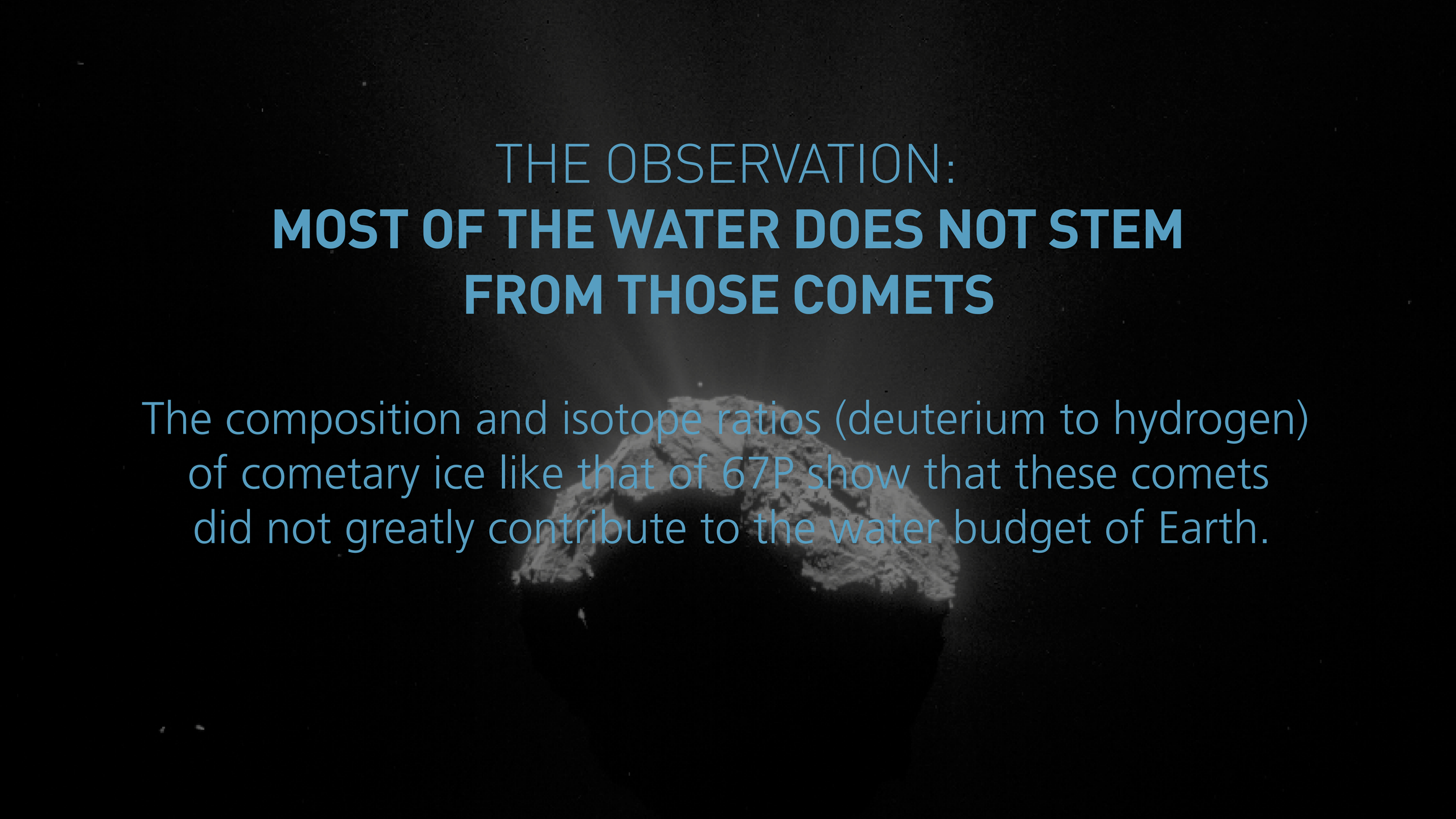
That is, 67P seems to have experienced very mild collisions.

Therefore, the model is not consistent with the observation.

THE FOURTH HYPOTHESIS:
THE WATER ON EARTH WAS BROUGHT BY COMETS

Comets brought – late in the accretion phase – water to Earth.





THE OBSERVATION:
MOST OF THE WATER DOES NOT STEM FROM THOSE COMETS

The composition and isotope ratios (deuterium to hydrogen) of cometary ice like that of 67P show that these comets did not greatly contribute to the water budget of Earth.

THE FIFTH HYPOTHESIS:
COMETS DELIVERED MOLECULES IMPORTANT FOR LIFE

Even before the Rosetta mission, it was known that the ice and dust of comets contain numerous organic molecules in addition to inorganic molecules:

Carbon compounds and hydrocarbons,
which are the basic ingredients of all life on Earth.

THE OBSERVATION:
COMPLEX ORGANIC COMPOUNDS ARE GENERATED ON COMETARY SURFACES

Rosetta has confirmed that comets harbour amino acids.

This observation does not ‘prove’ that life came from comets.

Rather, it shows that complex organic molecules may form on other bodies than Earth. And it suggests that life may not only have originated on Earth.

BILDER IMAGES

WEITERE INFORMATIONEN
MORE INFORMATION
DLR.DE/ROSETTA-AUSSTELLUNG