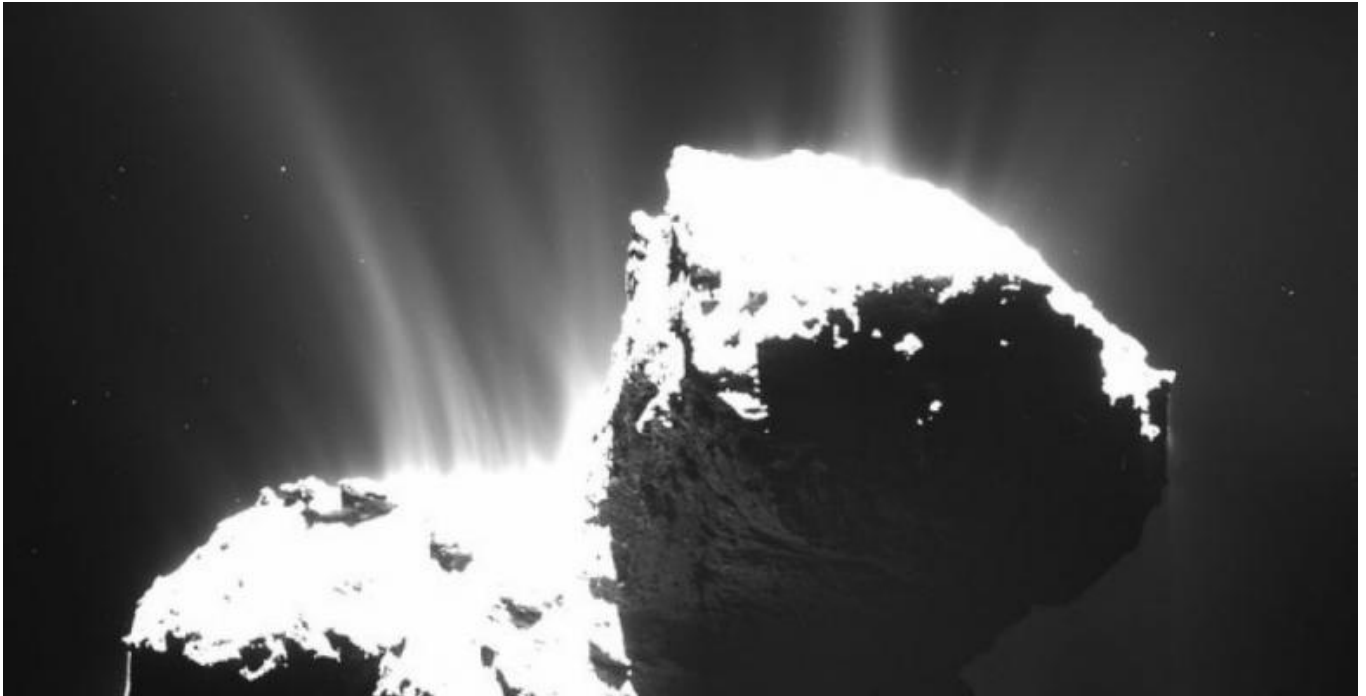

Rosetta Finds Out Much About a Comet, Even With a Wayward Lander

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Scientists working on the mission described their initial observations of [Comet 67P/Churyumov-Gerasimenko](#) in seven articles published Thursday in the [journal Science](#). “This sets the baseline for the rest of the mission,” said Matt Taylor, the project scientist.

Rosetta arrived at the comet in August after a trip of 10 years and four billion miles. For the first time, scientists are having an extended look at a comet as the spacecraft accompanies it for at least a year as it swings around the sun. As the comet heats up, it will spew greater amounts of gas and dust.

In November, a washing-machine-size lander named Philae made it to the surface, but systems designed to anchor it failed, and the lander bounced, ending far from the intended site in a position that greatly reduced the amount of sunlight hitting its solar panels. Instruments on the lander operated for two days until the batteries drained.

Photo



A close-up of the "neck region" of the rubber-duck-shaped comet. Credit European Space Agency

In mid-December, the orbiter's high-resolution camera took pictures of the spot where the scientists think the lander ended up, but the scientists were not able to find it — a few pixels in a four-million-pixel image.

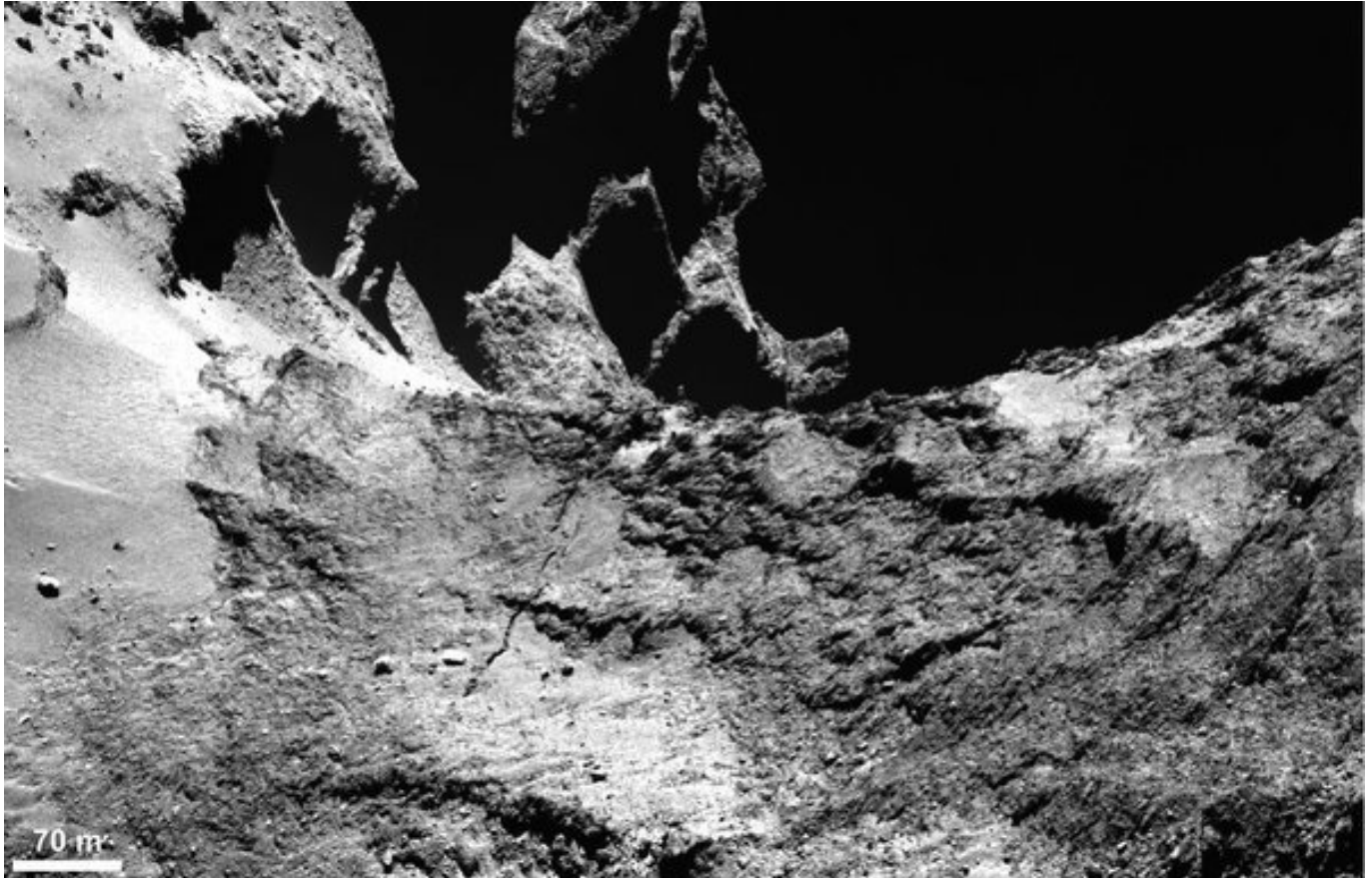
Holger Sierks, the principal investigator for Rosetta's main camera, said that Philae, which photographed its surroundings and performed various measurements after landing, was still expected to awake in the spring when increasing sunlight recharged the batteries. Even if Philae does not wake up, Rosetta should be able to spot it after the comet has made its closest approach to the sun, in August.

The high-resolution camera has taken photographs with a resolution as fine as two and a half feet per pixel. The comet, just two and a half miles wide with a two-lobe shape that resembles a rubber duck toy, has a remarkably wide variety of terrain. That includes smooth dust-covered regions, fields of boulders, steep cliffs and large depressions that may have been blown out by underground melting of carbon dioxide. The variety is surprising because many think the comet is, by and large, made of the same material throughout. Scientists are not sure if the shape comes from two smaller comets that bumped and stuck together or one large comet that eroded in an unusual manner.

On the surface of Comet 67P, there are even what look like ripples of sand dunes like those seen on [Earth](#) and Mars. That appears befuddling, as a comet has no atmosphere — and so no wind — and only a wisp of gravity.

“You have to ask yourself, is that possible?” said Nicolas Thomas, a professor of experimental physics at the University of Bern in Switzerland and lead author of one of the papers. Dr. Thomas said that back-of-the-envelope calculations indicated that it might be plausible, with the jets of gas acting as wind and the particles held together through intermolecular attraction known as the van der Waals force instead of gravity. “You can convince yourself you can make them move,” Dr. Thomas said. “It’s plausible, at least at the moment.”

Photo



A large fracture running across the comet. Credit European Space Agency

The scientists split the surface into 19 regions based on terrain, naming them after Egyptian gods. Rosetta is named after an inscribed rock, found in Egypt, that proved crucial in deciphering ancient hieroglyphics.

In another region, along the comet’s “neck,” is a cliff about 3,000 feet high with fractures hundreds of feet long. The scientists cannot agree on what they are seeing, whether the lines reflect layering in the material making up the comet or cracks caused by the heating and cooling of the material as it passes in and out of sunshine.

In the smooth regions, there are circular structures. “Which look very, very bizarre,” Dr. Thomas said. “To be frank, we don’t know how those things were created. We have no clue.”

There is also a long crack, about a yard wide and several hundred yards long, that runs around the neck. Dr. Thomas said it was unclear whether the comet was about to snap in two.

The jets of gas currently emanate from the neck area, a region named Hapi. That, too, seems counterintuitive because the neck is often in shade and cooler. But Dr. Sierks said the area was still warm enough and gravity was weaker there, allowing particles to escape more easily.

The scientists previously described some of the most significant findings reported in the Science papers — that the water on the comet does not resemble that found on [Earth](#), probably ruling out comets as the source of the Earth's oceans, and that a diverse stew of molecules streaming off the surface includes those found in the odors of rotten eggs and urine.
