Rosetta's climactic trek to comet comes to an end

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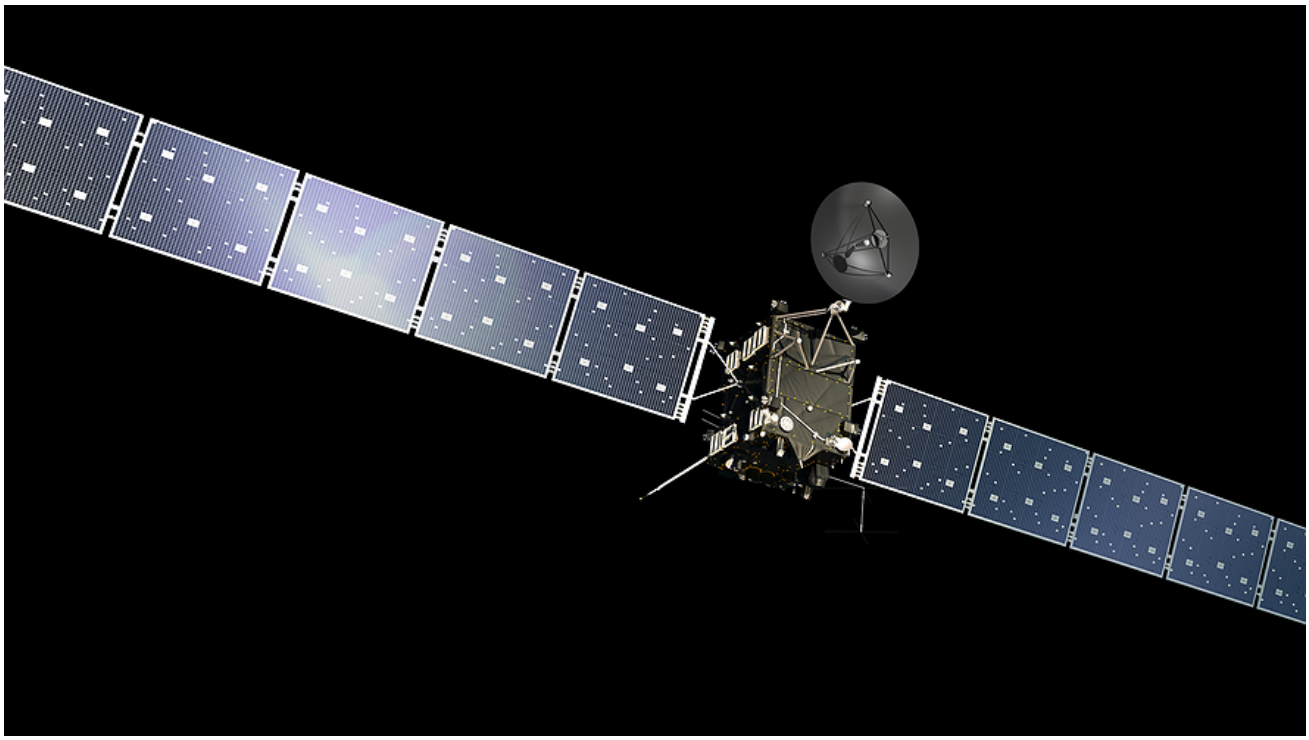

An artist's impression of the Rosetta orbiter on a black background. Photo: ESA/ATG medialab/Wikimedia Commons

It was conceived when Ronald Reagan was in the White House. It launched a few weeks after Mark Zuckerberg created Facebook in his Harvard dorm. It spent 10 years looping around the solar system. When it finally caught up with its target, it deployed the first lander to reach a speeding comet and survive.

Now the long, dramatic journey of the Rosetta space orbiter is about to end. After logging 4.9 billion miles, the craft is set to commit operational suicide early Friday morning, purposely falling to the surface of the comet it has been following for the last two years. The mountain-sized comet is named 67P/Churyumov-Gerasimenko.

But first it has just a bit more science to do.

During its final descent, Rosetta will gather close-range information about the comet and beam it back to Earth before its main transmitter shuts off for good.

Bittersweet Journey

“It’s kind of bittersweet,” said Paul Weissman, a comet scientist at the Planetary Science Institute in Tucson, Arizona, who worked on Rosetta for 20 years. “You’d like to keep going, but it is also very satisfying. It’s been a tremendously successful mission.”

The $1 billion mission has been full of suspense.

Its many plot twists began before the spacecraft left Earth, when a flawed rocket postponed the launch by two years. Mission planners at the European Space Agency (ESA) had to abandon their original comet and select a different one.

The new comet, 67P, was four times larger than the first target, and meeting up with it required a longer flight than originally planned. Between March 2004 and January 2014, Rosetta made three Earth flybys and one close pass by Mars, using the planets’ gravity to give it a boost.

Two-Year Hibernation

Along the way, it imaged two asteroids and endured a hibernation of two years, seven months and 12 days.

Engineers programmed four alarm clocks to wake the spacecraft from its long slumber. Everything hinged on its ability to boot back up, said Rosetta Flight Director Andrea Accomazzo.

“Either we had a mission, or we had no mission at all,” he said.

Accomazzo got the wake-up signal on January 20, 2014 — 40 nail-biting minutes late.

Scientists are fascinated by comets. They believe they were formed in the earliest days of the solar system, and that frozen inside are the same materials that make up the planets.

As Rosetta closed in on its target, researchers were dazzled by the strange and unexpected shape that gradually came into focus. The comet was roughly 2.5 miles across and had two lobes that resembled a rubber duck with a head, thin neck and rounded body. In time, Rosetta’s instruments revealed a world of towering cliffs, deep pits and massive boulders.

“It was a big surprise,” said Claire Vallat, a scientist at the agency’s European Space Astronomy Center.

Washing-Machine-Sized Lander

After officially entering 67P’s orbit on August 6, 2014, Rosetta spent several months mapping the surface to find the best spot to send Philae, its 220-pound washing-machine-sized lander. The mission team selected a site that got enough sunlight to power Philae’s solar panels, and that appeared to have shallower slopes and fewer boulders than other areas.

On November 12, 2014, scientists were once again on the edge of their seats as Philae made a seven-hour descent to the surface of 67P. It was humanity's first attempt to make a soft landing on a comet.

The move did not go exactly as planned. The lander's harpoons failed to fire, and Philae bounced twice before coming to rest in what remained an unknown location for nearly two years.

It soon became clear that Philae's solar panels would not receive enough sunlight to keep powering the onboard instruments, so it was able to conduct experiments for only 60 hours before shutting down. But mission scientists insist that Philae is no failure.

"Philae sent back quite a bit of information for three days," Weissman said. "We didn't learn everything we wanted to from the lander, but we did learn a lot."

Rendezvous With A Comet

Rosetta continued to orbit the comet as it made its closest approach to the sun in August 2015. From a safe distance of 186 miles, it watched as 67P became more active, with streams of dust and gas shooting off its surface. The comet's display subsided as it flew farther from the sun.

"Rosetta had a major goal in mind, which was to rendezvous with a comet far from the sun and watch it wake up and then let it die down again," said Laurence O'Rourke, a lander systems engineer at ESA. "Overwhelmingly, we have met that goal."

But the drama was not over yet. Less than one month before the mission's end, Rosetta's cameras spotted Philae wedged into a dark crack on the comet's surface. Two of its legs were sticking up in the air.

Finding Philae after all that time "was like drinking a bottle of adrenaline," O'Rourke said. "I couldn't sleep for the whole night."

Now Rosetta has reached the end of its journey. Comet 67P is on its way toward the orbit of Jupiter, and soon Rosetta's 100-foot solar panels will be too far from the sun for the spacecraft to work.

"Operating Rosetta beyond this point wouldn't be possible," Accomazzo said.

Experts say there is no chance the orbiter will survive its planned Friday-morning crash with the comet.

Quiz

1 Which two of the following sentences from the article include central ideas of the article?

1. *After logging 4.9 billion miles, the craft is set to commit operational suicide early Friday morning, purposely falling to the surface of the comet it has been following for the last two years.*
2. *As Rosetta closed in on its target, researchers were dazzled by the strange and unexpected shape that gradually came into focus.*
3. *From a safe distance of 186 miles, it watched as 67P became more active, with streams of dust and gas shooting off its surface.*
4. *"Rosetta had a major goal in mind, which was to rendezvous with a comet far from the sun and watch it wake up and then let it die down again," said Laurence O'Rourke, a lander systems engineer at ESA.*

(A) 1 and 3

(B) 1 and 4

(C) 2 and 3

(D) 3 and 4

2 Which statement would be most important to include in a summary of the article?

(A) The wake-up signal that would tell the flight director there was still a mission came 40 minutes late on January 20, 2014.

(B) Paul Weissman is a comet scientist at the Planetary Science Institute in Tucson, Arizona who didn't learn everything he wanted to from Philae.

(C) Researchers want to study comets, because they may contain materials that were formed around the time the solar system was formed.

(D) Comet 67P is larger than the original target comet and is now beginning to travel toward Jupiter's orbit.

3 A reader of the article suggested that the author included the section "Bittersweet Journey" to describe obstacles faced by the mission. Is this accurate? Which line from the article BEST supports your answer?

(A) Yes; “It’s kind of bittersweet,” said Paul Weissman, a comet scientist at the Planetary Science Institute in Tucson, Arizona, who worked on Rosetta for 20 years.

(B) Yes; Its many plot twists began before the spacecraft left Earth, when a flawed rocket postponed the launch by two years.

(C) No; Mission planners at the European Space Agency (ESA) had to abandon their original comet and select a different one.

(D) No; The new comet, 67P, was four times larger than the first target, and meeting up with it required a longer flight than originally planned.

4 Why does the author include the following quote in the section "Rendezvous With A Comet"?

Finding Philae after all that time “was like drinking a bottle of adrenaline,” O’Rourke said. “I couldn’t sleep for the whole night.”

(A) to highlight how upset scientists were when Philae was lost

(B) to show how the mission's end relieved scientists

(C) to highlight how important the Rosetta mission was

(D) to show how overwhelming it was to find Philae on 67P