Philae: life and times of a comet lander

Rosetta mission images reveal spacecraft activity before hibernation.

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A key phase of the Rosetta mission by the European Space Agency (ESA) came to an end on 15 November as the Philae lander ran down its battery and entered hibernation. The spacecraft landed on comet 67P/Churyumov–Gerasimenko (or 67P) on 12 November after a journey of more than 10 years.

Philae was active on the comet for only about 64 hours, but the lander managed to complete most of its main science programme.

Nature looks at Philae's brief burst of scientific activity on 67P — and at what the future may hold for the spacecraft.

The journey begins

Francis DEMANGE/Gamma-Rapho via Getty Images

The Rosetta mission launched on 2 March 2004 from Kourou in French Guiana, beginning its long journey to 67P. Scientists hope that Rosetta mission data will help them to understand conditions in the early Solar System, including whether comets like 67P brought water or organic molecules to Earth.

The comet comes into view

ESA/Rosetta/NAVCAM

Researchers were surprised when the Rosetta beamed home images in July 2014 showing that Comet 67P, at roughly 4 kilometres long, is shaped like a rubber duck. “It’s more than a pleasant surprise — I was amazed by the images,” Stephen Lowry, an astrophysicist at the University of Kent, UK, told *Nature*. But the comet's unusual shape also made it harder to plan Philae's landing.

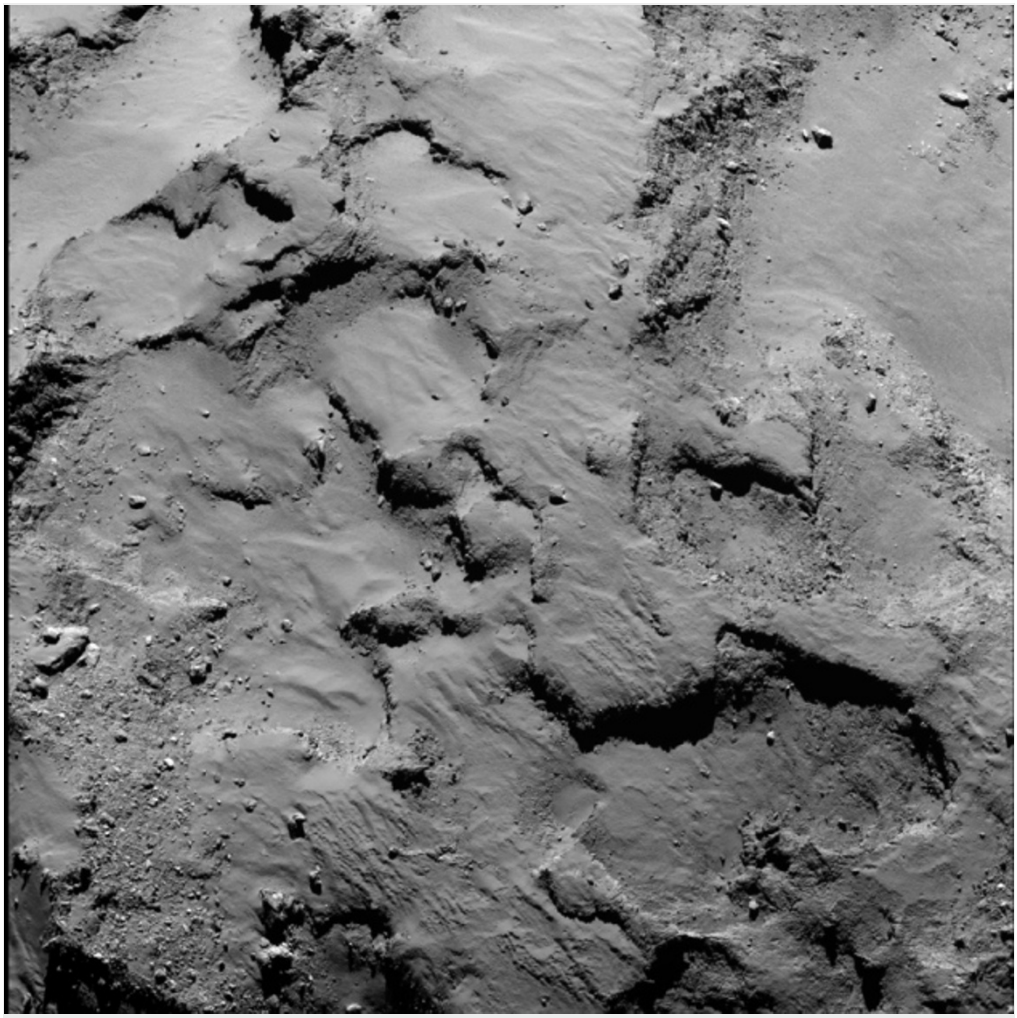
Degree of difficulty

ESA/Rosetta/NAVCAM

Images from Rosetta provided a better view of 67P in August, when the probe was roughly 79 kilometres from its target. Before the researchers knew of the comet's unusual shape, they had estimated the

likelihood of a successful landing on the comet at 70–75%. After discovering 67P's duck-like contours, Mark McCaughrean, a senior science adviser at the ESA directorate of science and robotic exploration in Noordwijk, the Netherlands, put the odds at roughly “fifty-fifty”.

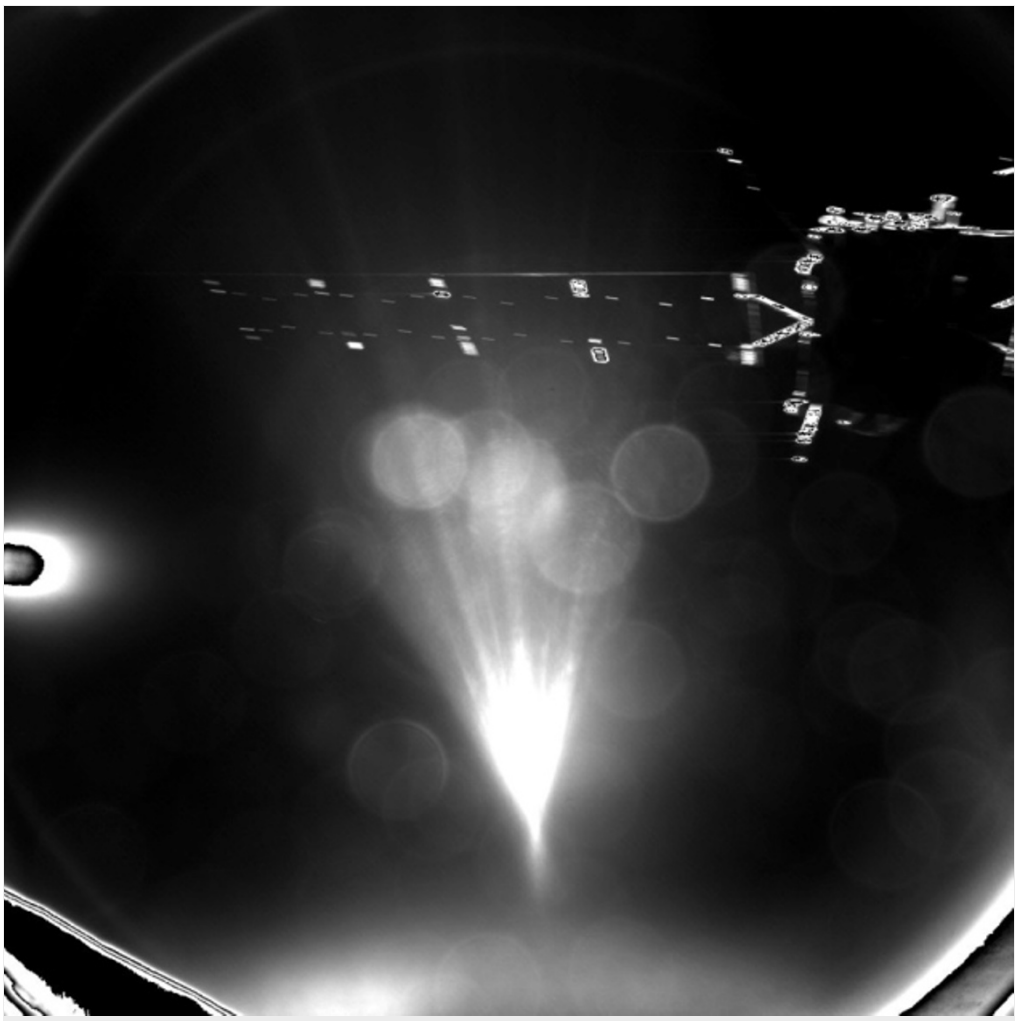
Target chosen



ESA/Rosetta/MPS for OSIRIS Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA

The Rosetta team eventually chose Site J (later named Agilkia) as Philae's touchdown target. The site sits on the 'head' of Comet 67P.

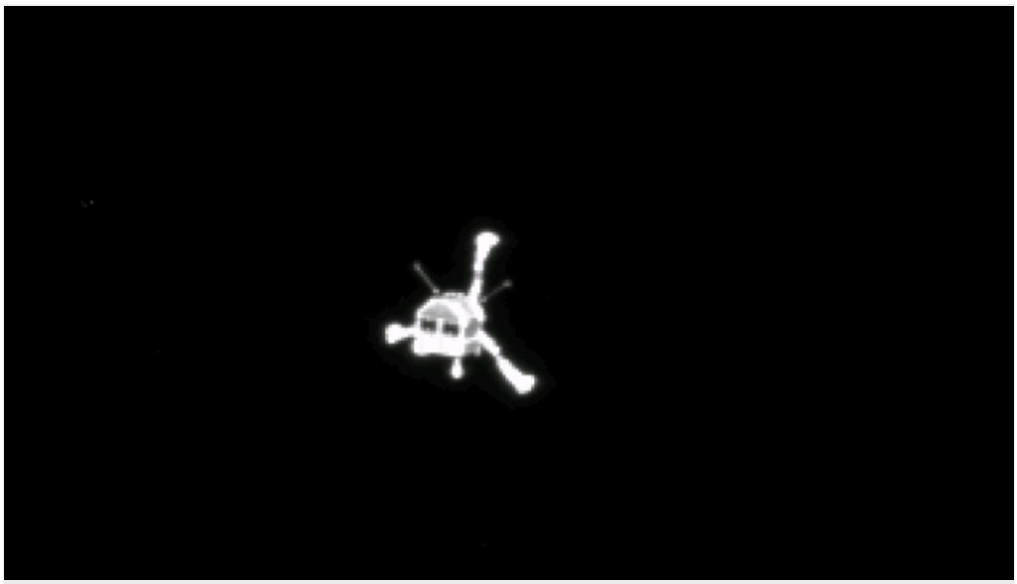
Rosetta in the rear-view mirror



ESA/Rosetta/Philae/CIVA

Philae snapped this image of one of Rosetta's solar arrays during its journey toward Comet 67P. The lander separated from Rosetta at 9:35 a.m. Central European Time on 12 November.

On its way



ESA/Rosetta/MPS for OSIRIS TeamMPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA

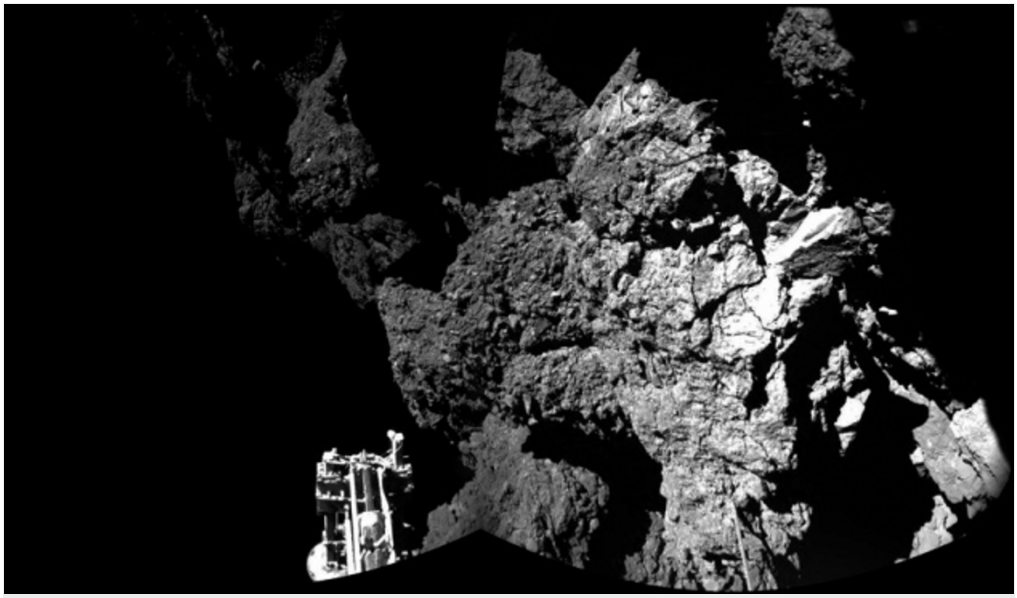
Rosetta's OSIRIS camera captured an image of Philae shortly after the lander began its solo journey to the comet.

Philae phones home

J. Mai/ESA/picture-alliance/dpa/AP Images

Scientists celebrated as the first signals from the lander reached the European Space Operations Centre in Darmstadt, Germany, on 12 November — the culmination of a journey that lasted more than a decade, and the first soft landing of a spacecraft on a comet.

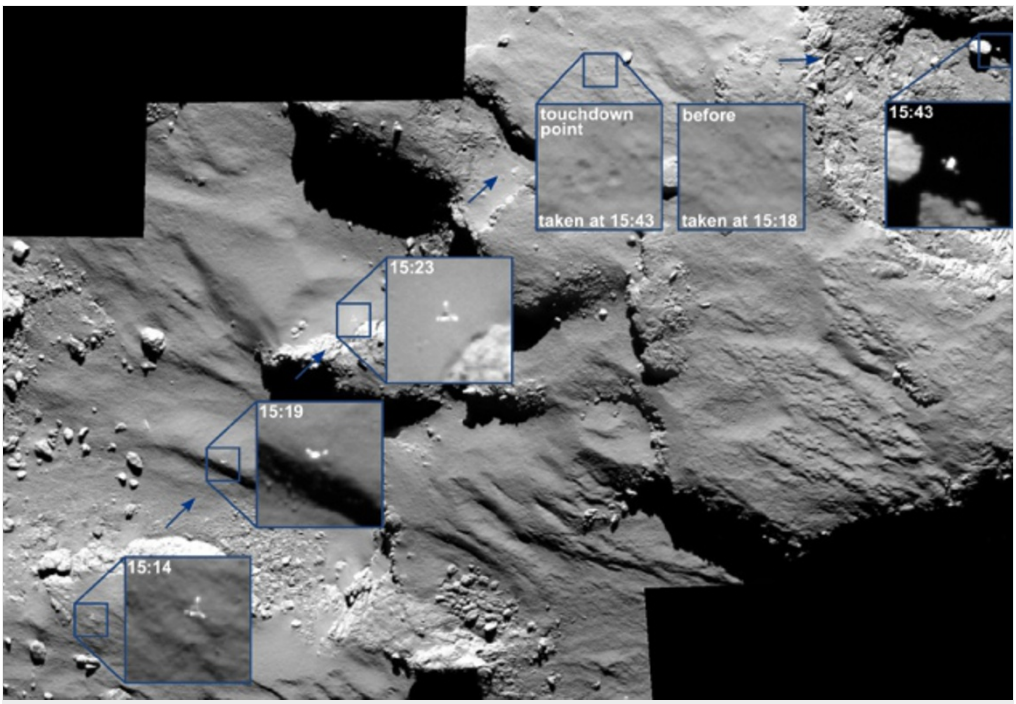
Eyes open



ESA/Rosetta/Philae/CIVA

The first images from Philae's CIVA (Comet nucleus Infrared and Visible Analyzer) camera confirmed that the craft had landed askew, on a rocky cliff. One of the lander's three feet can be seen in the foreground of this panoramic image. With little sunlight available to recharge its battery, Philae raced against time to image the comet and drill into its surface.

A big bounce



ESA/Rosetta/MPS for OSIRIS Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA

The Rosetta science team is now working to reconstruct Philae's path after its initial landing on the comet. The latest analysis, published by ESA on 17 November, draws on images taken by Rosetta's OSIRIS camera to document Philae's landing. Researchers think that Philae touched down and bounced before coming to rest roughly 1 kilometre away from its intended landing site. (The boxes on the photo show three positions of Philae before landing, the initial landing site, and Philae's first rebound.)

As Philae's battery ran down, researchers tried a last-minute maneouvre to adjust the position of its solar panels in the hope that Philae could capture enough solar energy to reawaken at some point in the future. Now they are left to watch and wait. Comet 67P is expected to come closest to the Sun on 13 August 2015.

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