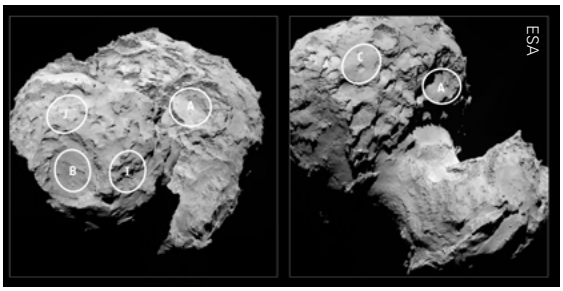
Where will Philae land?

Tom Lyons

An impression of Philae touching down on Comet 67P

As the Rosetta spacecraft orbits Comet 67P, the project scientists must choose a landing site for Philae. Philae is a smaller spacecraft which will be dropped from Rosetta onto the surface of the comet. Five possible landing sites have been chosen. More detailed pictures will need to be taken to assess the terrain of these landing sites – large numbers of boulders or very steep slopes would not be good to land on. A final decision as to the landing site and date made in October 2014.



Site A Located on the large lobe but with a good view of the smaller lobe. Chosen because the region between the two lobes is the likely source of some 'outgassing'. As the comet approaches the Sun, heating will cause it to outgas more material, eventually producing the familiar coma of the comet (its tail). At present, two cups of water per second are evaporating from the comet. This will increase hundreds or thousands of times over the coming months.

Site B Located in the crater-like structure in the smaller lobe. Relatively safe for landing due to the flat terrain but the lack of sunlight on the solar panels may cause a problem for the power requirements of the lander.

Site C Located on the larger lobe, it has a range of features such as cliffs, smooth plains and depressions and it is well illuminated.

Sites I and J Both located on the smaller lobe in relatively flat areas with good illumination conditions.

Landing on a comet

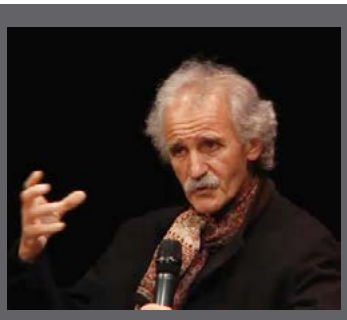
In mid-November, Philae will be pushed backwards behind Rosetta and fall towards the comet, touching down at around 1 m/s. Two harpoons will be fired to anchor to the surface. The energy of the impact will be transferred by a shock absorption system into electrical energy to help prevent an elastic rebound.

The drag from the gas in the coma of the comet means that it is difficult to predict exactly where Philae will touch down and the scientists must deal with an uncertainty of 1 square kilometre in their planning. The comet rotates on its axis once every 12 hours, further adding to the complexity of the landing.

Together Rosetta and Philae will measure the composition of the gaseous material leaving the comet, take samples at the surface and use radio waves to map the interior of the comet. Philae will also provide detailed information on the structure of the comet, never before obtained. It will hopefully give us insights into our early solar system and perhaps into the origin of life on Earth. All this on an object hurtling through space at around 55 000 km/hr, hundreds of millions of kilometres from the Sun.

Tom Lyons has worked as an engineer on space satellite systems. He is now based at the National STEM Centre in York.

See Catalyst Vol 24 Issue 4 (April 2014) for Tom Lyons' previous article about the Rosetta mission.



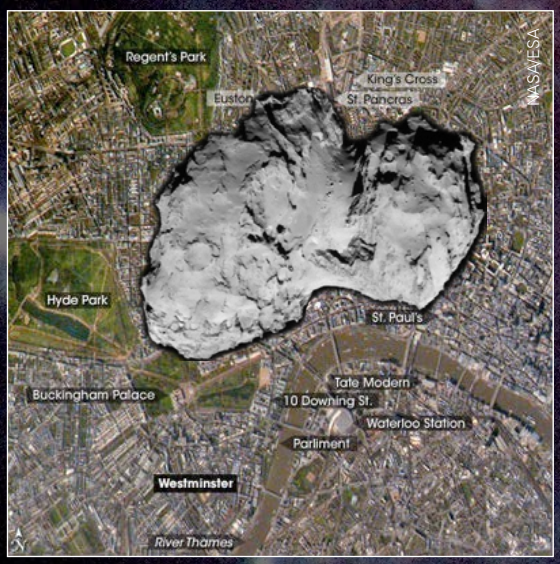
Jen Pierre Bibring is the French scientist in charge of the Philae lander.

"The comet is very different to anything we've seen before, and exhibits spectacular features still to be understood," says Jean-Pierre Bibring, a lead lander scientist and principal investigator of the CIVA instrument. "The five chosen sites offer us the best chance to land and study the composition, internal structure and activity of the comet with the ten lander experiments."

ROSETTA IN ORBIT

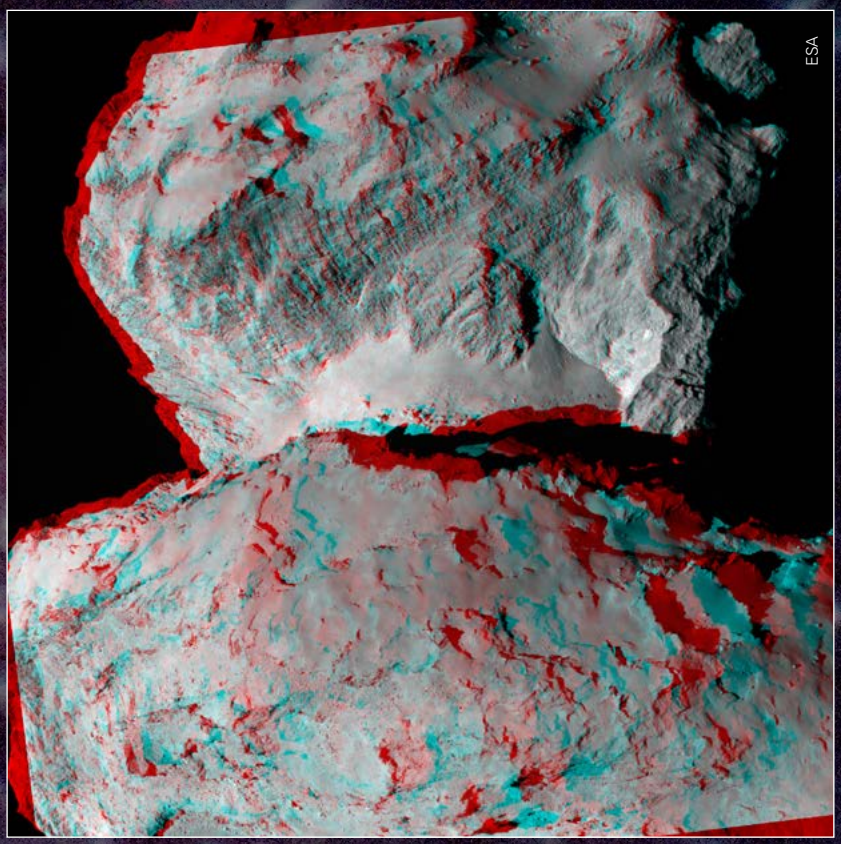
After a 10 year journey through space, the Rosetta spacecraft arrived at Comet 67P/Churymov-Gerasimenko on 6th August 2014. Rosetta's cameras show that the comet has two clearly defined lobes, one larger than the other – it may have formed when two bodies collided. Pictures of its surface also show that it is darker than might be expected for an icy body, suggesting the surface is covered in dark dusty material.

Rosetta's high resolution camera, OSIRIS, took this photo when the probe was 100 km from the comet. Some scientists are calling Comet 67P the 'rubber duck' because of its shape.

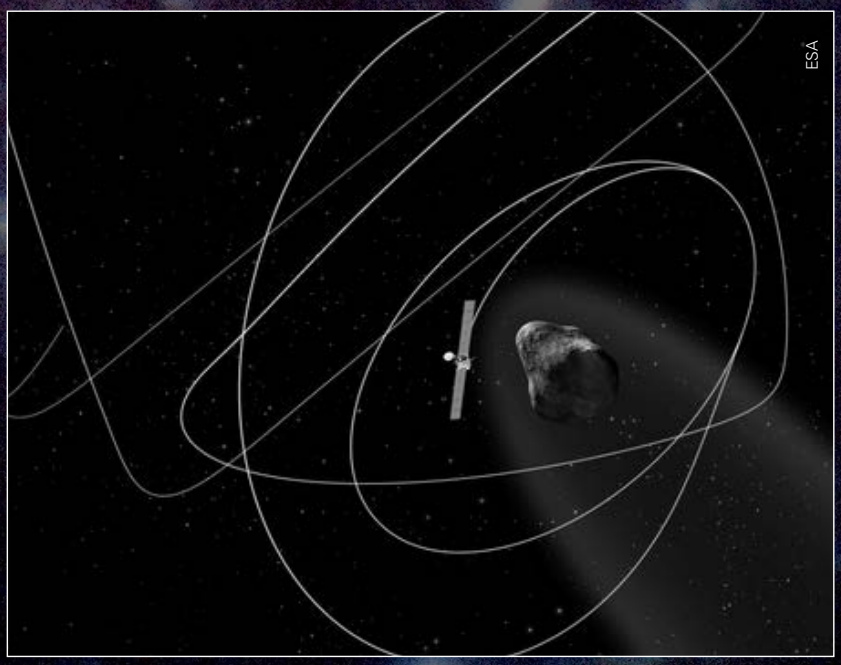


The nucleus of Comet 67P is around 4 km across. Here it is superimposed on a photo of London taken from the International Space Station.

It takes a team of engineers and scientists together with plenty of computing power to calculate and control the Rosetta mission to Comet 67P.



Use red/green stereo glasses to see Comet 67P in 3D.



As Rosetta approaches the comet, it has to do a set of complex manoeuvres to get closer. These require boosts from its rockets every few days. The curvature of the orbit between these boosts allows the scientists to determine a better estimate of the total mass of the comet – around 10 billion tonnes. The comet's density is approximately 300 kg/m^3 – less than one third the density of water.