Philae lander – sunny landing area on the comet 'head'

15 September 2014

When the Philae lander touches down on 11 November 2014, Comet 67P/Churyumov-Gerasimenko will have a landing site waiting for it with a varied but not too rugged landscape offering good solar illumination and hardly any steep slopes. In a two-day selection process, the lander team under the leadership of the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) selected landing site 'J' from among five possible candidates. The region on the head of the two-part comet was chosen after careful evaluation of all available data. "As we look at the current close-up images, we see that Comet 67P/Churyumov-Gerasimenko is a beautiful yet very extreme world; it is scientifically exciting, but has a shape that produces a big challenge for landing," says DLR researcher Stephan Ulamec, Project Manager for the Philae lander. "None of the five candidates satisfied 100 percent of the criteria, but landing site 'J' is clearly the best solution."

It will take around seven hours from the time Philae separates from the ESA Rosetta mother craft until, for the first time ever, a lander will be on the surface of a comet. This amount of time allows the engineers and scientists to ensure that too much electrical energy is not consumed during the descent and so, immediately afterwards, implement a sophisticated plan to operate all 10 instruments. During this 'First Science Phase', the lander, which is controlled and monitored from the Lander Control Center (LCC) at DLR Cologne, will be powered by its batteries. Subsequently, an average of seven hours of sunlight per cometary 'day' will allow the batteries to be repeatedly recharged. This is why the team selected a 'sunny' location. The region is scientifically interesting in particular because of the expected activity of the comet as it continues along its path towards the Sun. There are depressions in the vicinity of landing site 'J' that may already be active.

Analyses for a safe landing

In addition to trajectory calculations and the first results from the instruments on board the Rosetta spacecraft, the planning also incorporates data from, for example, a number of landing tests conducted at DLR Bremen. During the spring of 2013, engineers there used a full-size model to test landings on both hard and soft ground in the LAMA Landing and Mobility Test Facility. Computer simulations have enabled the challenges posed by the various landing sites to be investigated.

In the coming weeks, the landing site will be examined from a shorter distance and more accurate trajectory calculations will be performed for the orbiter and lander. Should it turn out, for example, that the terrain within the landing region is significantly more rugged than expected or that extreme outgassing of the comet at this location could jeopardise the landing, then landing site 'C' has been selected as a backup. This landing site is on the larger part, the 'body' of the comet, and is located in relatively flat terrain and has plenty of sunlight.

The other landing sites, 'I', 'B' and 'A', which were shortlisted, were rejected because it was found during the detailed analysis that they did not meet some of the criteria sufficiently well. For example, it became clear when analysing the images acquired from some 30 kilometres away that landing site 'B', which is located inside a crater-like structure, had larger and more numerous boulders than first thought.

Preparations for the big day

By committing to a landing site and thus enabling more refined trajectory calculations, the engineers at the LCC, among others, can adjust and optimise the sequence for the descent and landing. This will be carried out autonomously by Philae – descending to the comet and

preparing for its operations on 67P/Churyumov-Gerasimenko without intervention from Earth. The activities of the flight unit are tested in advance using a ground reference model of the lander in the LCC. The commands for Philae and its ten instruments are sent from the LCC to the European Space Operations Centre (ESOC) in Darmstadt and from there via ground stations to Rosetta and Philae. The telemetry from Philae passes in the opposite direction via ESOC to the LCC.

On 15 October 2014, the landing site selection will be finally confirmed or a decision will be made to switch to the backup site. "Now we have a place to land, so we are preparing for the big day," says Stephan Ulamec.

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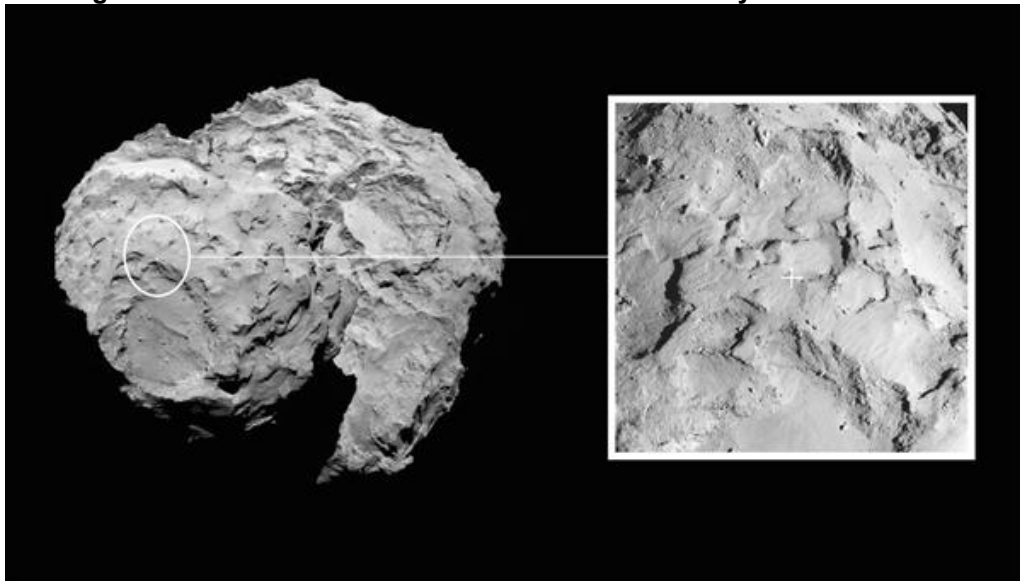*Dr Stephan Ulamec*
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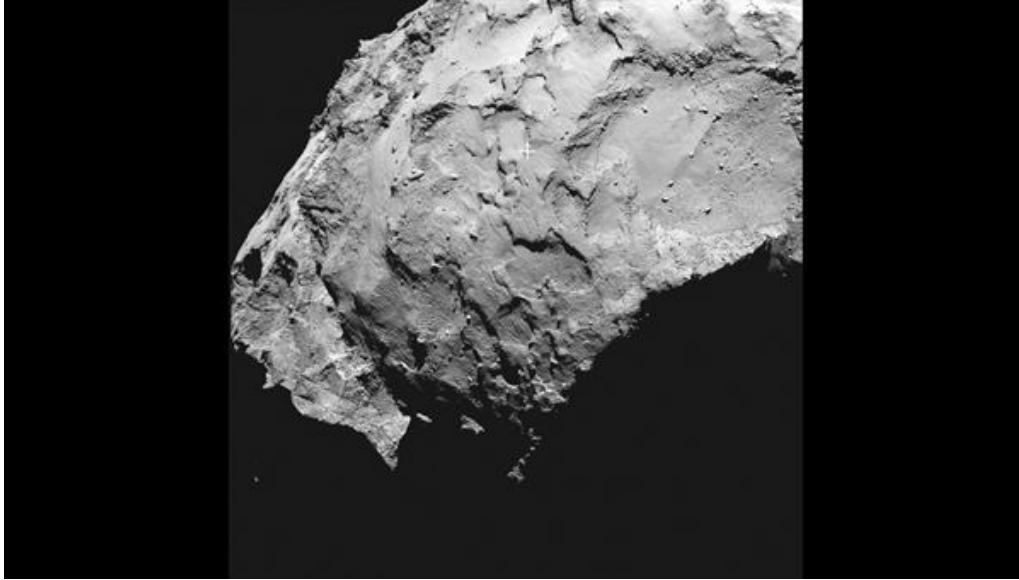*Stephan.Ulamec@dlr.de*

Landing site 'J' is located on the 'head' of Comet 67P/Churyumov-Gerasimenko

The OSIRIS camera acquired this image on 16 August 2014 from a distance of about 100 kilometres.

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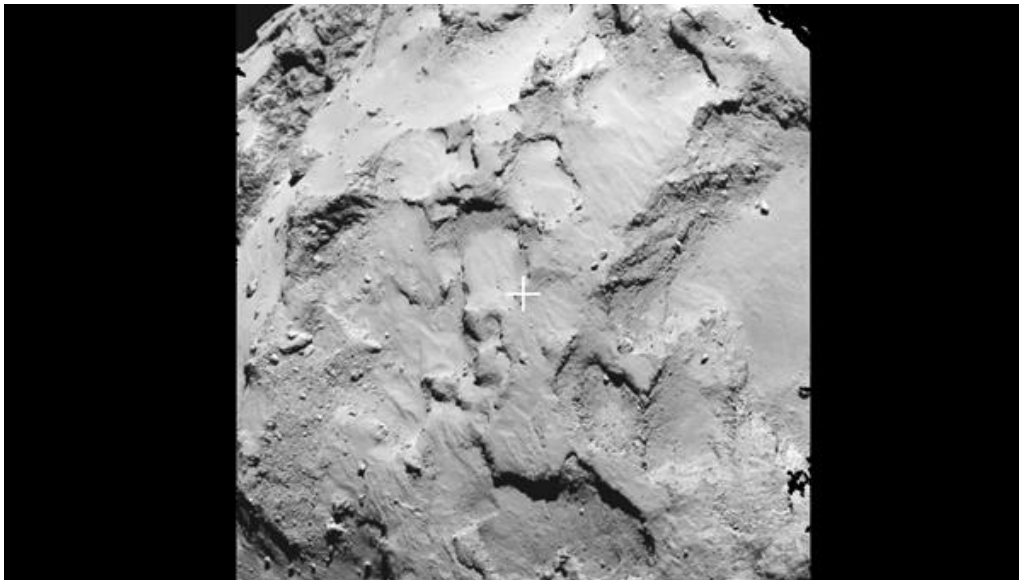
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Credit: ESA/Rosetta/MPS for OSIRIS Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA.

It is planned that Philae will touch down on Comet 67P/Churyumov-Gerasimenko on 11 November 2014

The cross marks the centre of the landing ellipse for landing site 'J', selected for the first ever landing on a comet.

Credit: ESA/Rosetta/MPS for OSIRIS Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA.
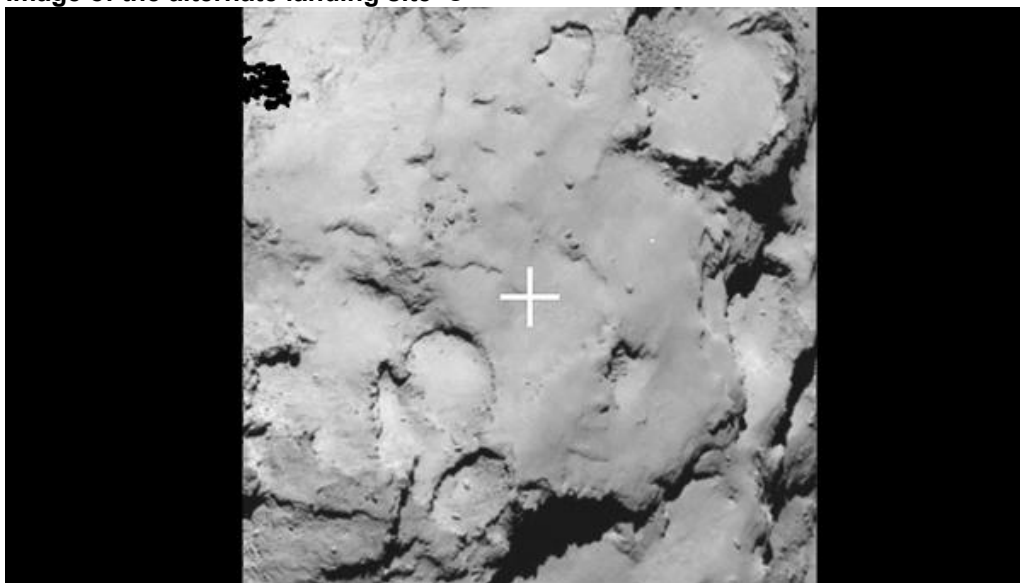
The 3D image of landing site 'J' shows that only a few steep slopes are located in the landing ellipse
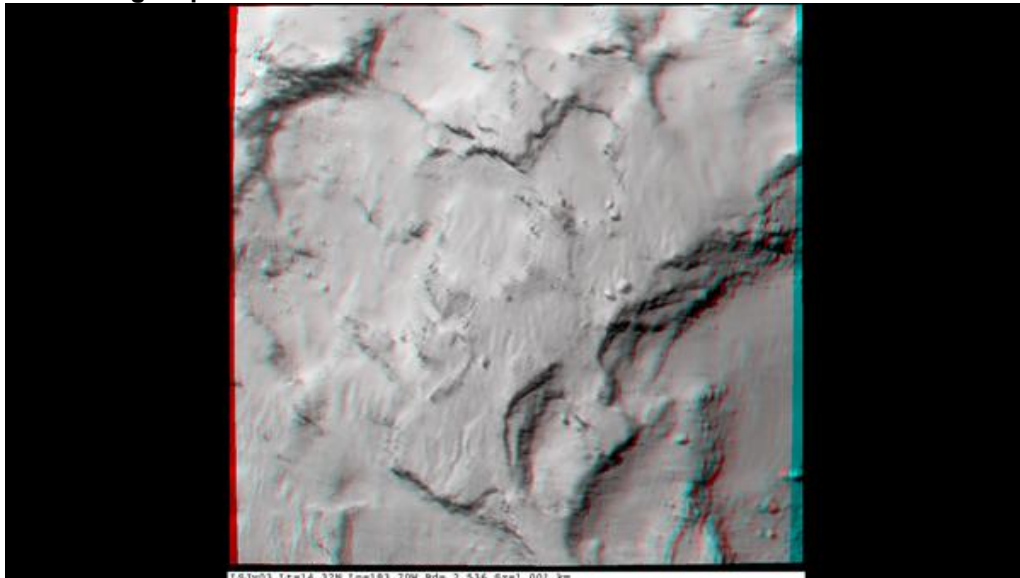
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Credit: ESA/Rosetta/MPS for OSIRIS Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA.

Image of the alternate landing site 'C'

Landing site 'C' was selected by the lander team for use in the event that the primary landing site, 'J', has to be excluded after detailed analysis.

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

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