



The search for the 'perfect' landing site

21 August 2014

When the Philae lander reaches its landing site on Comet 67P/Churyumov-Gerasimenko, it needs to be at a level yet scientifically interesting location, with enough sunlight and the right conditions to ensure a long working life. However, the rugged, unusually shaped comet is not making the choice easy for the lander team. The consortium, led by the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR), has until 24 August 2014 to choose up to five potential landing sites, so that these can then be studied in detail. The candidate sites will be announced on 25 August. On 11 November 2014, the lander component of the European Rosetta mission, which is controlled and operated by the DLR Lander Control Center (LCC), is scheduled to carry out the first ever landing on a comet.

"In selecting the landing site, we have to take many criteria into consideration and weigh them up against each other," says DLR scientist Stephan Ulamec, Project Manager for the Philae lander. "As we do so, it is certain that there will not be a perfect landing site – in reality, we will never find one. It just needs to be the best landing site that the comet has to offer." Therefore, the team, consisting of DLR, the French space agency, CNES, and various leading scientists for the lander's instruments, are currently discussing the pros and cons of various landing sites.

The DLR is contributing to this process things such as information on what the prospective landing sites will mean for the lander itself. For example, will there be enough hours of sunlight to charge the batteries and how long will it take to acquire sufficient energy? What effect will the temperatures have on Philae? Could the lander overheat, or become too cold? The other partners are providing information on things such as the flight path of the orbiter and lander and the amount of sunlight that the lander will get at the various landing sites. These evaluations are based on images acquired by the cameras on board the orbiter that show the shape and surface texture of the comet. In addition, instruments such as VIRTIS on board Rosetta have already provided information such as the average temperature on the surface of the comet. Initial data on the rotation of the comet, its gas and dust envelope and the extent of outgassing is also available.

Cautious selection

The initial selection of no more than five potential landing sites is hard enough. The comet, which consists of two connected parts, offers only a limited number of level, uniform surfaces on which Philae could land safely. The 'landing ellipses', within which the actual landing site lies, have a radius of around 500 metres: "We cannot determine the landing site more precisely," says Ulamec. As a control signal from Earth takes over 30 minutes to reach the lander, Philae must take care of the landing by itself, automatically, using a procedure pre-programmed by DLR and with no real-time corrective actions from the Control Center. Therefore, the lander team want to avoid regions with large boulders, rock or fissures, to reduce the risk for the Philae lander as much as possible. When the two harpoons are fired into the surface of the comet immediately after landing to anchor Philae, a slope with an angle of more than 45 degrees would still be reason enough to exclude a location as a suitable landing site.

"Also, we do not want to land in a site that has either constant daylight or night-time," explains the project leader for the lander. This would be unfavourable for the energy supply and temperature of the lander. After an initial phase in which all ten instruments on board Philae are used at least once, the lander needs to be supplied with solar energy for as long as possible. This second phase would then enable further scientific investigations to be carried out. In addition, the scientific users want a landing site with a day and night rhythm so they can study the comet under as many different conditions as possible.

Weighing up the criteria

Ultimately the selection will remain a case of constant trade-offs. How safe and low-risk does the landing need to be? Should a chance be taken, perhaps, and a more difficult landing site be selected – where the lifetime of the lander for carrying out scientific investigations would be longer? For example, if Philae lands in a crater on the 'head' of the comet, the region in the crater interior will very probably be smooth – but the amount of sunlight will be less than at the equator of 67P/Churyumov-Gerasimenko.

Once the decision on potential landing sites is taken on 24 August, the detailed work begins. The latest information from the instruments will be used to carry out calculations on whether the landing sites can be reached with the orbiter, so that Philae can ultimately descend onto the comet with precision. By 14 September 2014, the decision must be made as to which two landing sites go forward to the final selection. The decision on where Philae will land in November will be made in mid-October. The time for landing is most favourable when the comet is still some 450 million kilometres from the Sun. In recent months, 67P/Churyumov-Gerasimenko has been studied as it heads towards the Sun, to see how active it will become as its icy components are turned to gas by the heat, and dust particles are ejected into space in this process.

The mission

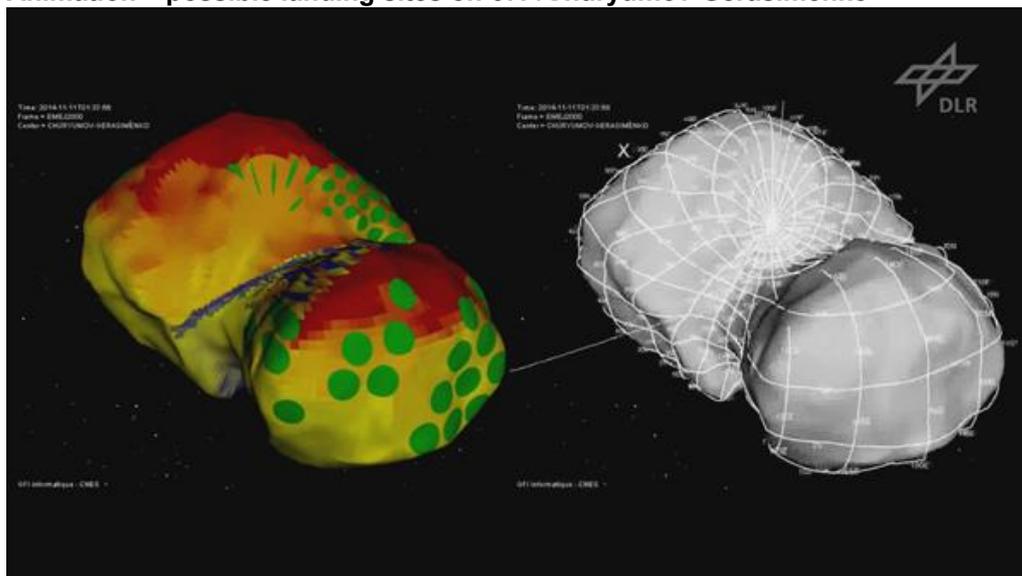
Rosetta is an ESA mission with contributions from its member states and NASA. Rosetta's Philae lander is funded by a consortium headed by DLR, the Max Planck Institute for Solar System Research (MPS), CNES and the Italian Space Agency (ASI).

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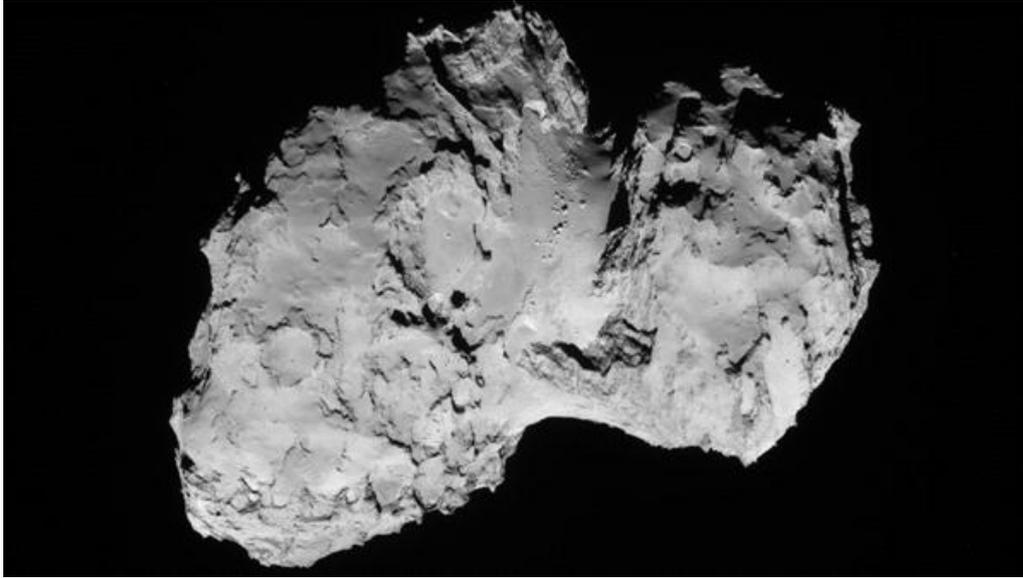
Animation – possible landing sites on 67P/Churyumov-Gerasimenko



The model shows the illumination of the surface and regions that might be suitable for a landing.

Credit: CNES.

Comet on 19 August 2014



Rosetta navigation camera image taken on 19 August 2014 at about 79 km from comet 67P/Churyumov-Gerasimenko. The comet nucleus is about 4 km across.

Credit: ESA/Rosetta/NAVCAM – CC BY-SA IGO 3.0.

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