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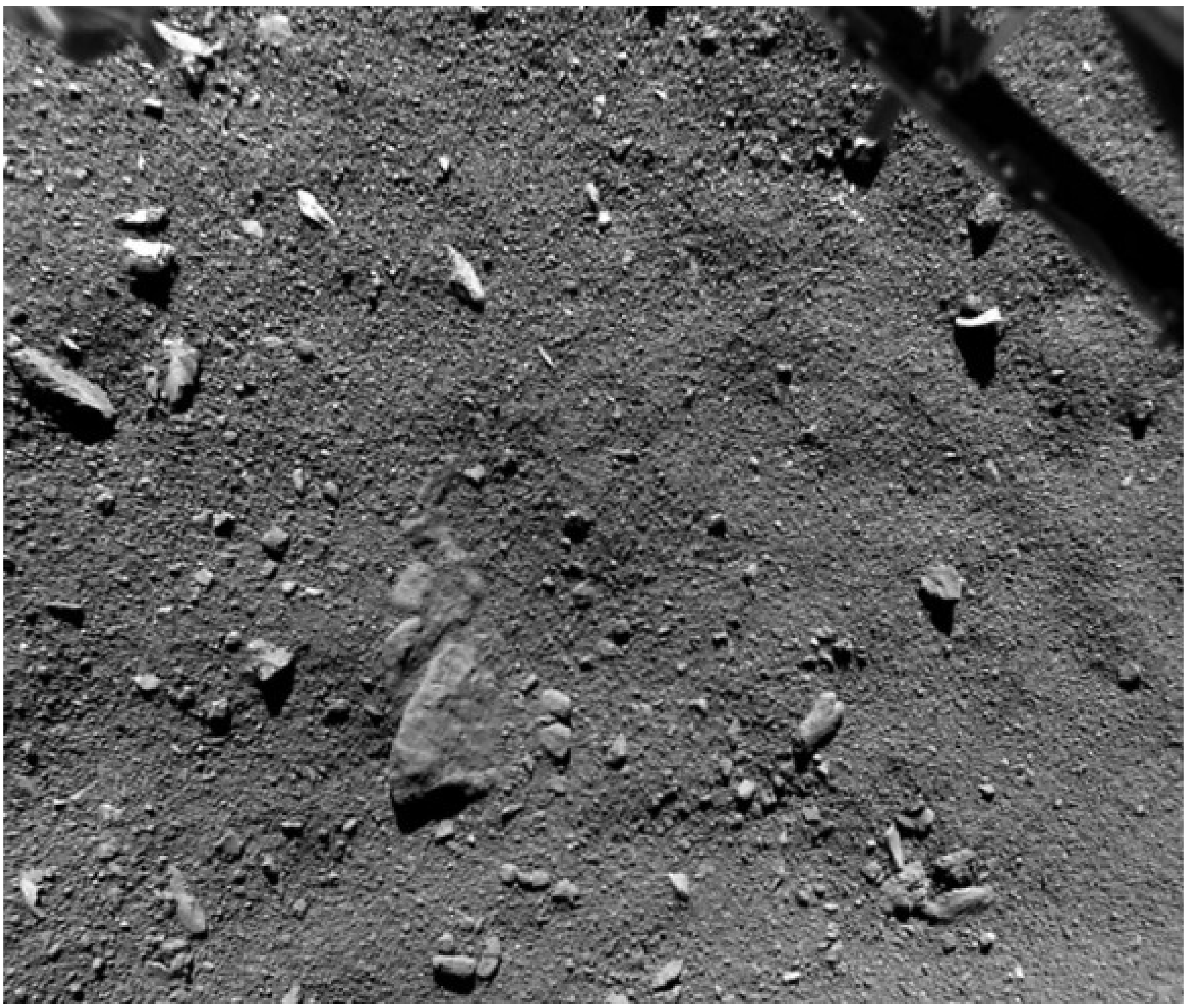
# T-minus 12 days to perihelion, Rosetta's comet up close and in 3D

August 3 2015, by Bob King



We’ve never seen a comet as close as this. Taken shortly before touchdown by the Philae lander on November 12, 2014, you’re looking across a scene just 32 feet from side to side (9.7-meters) or about the size of a living room. Part of the lander is visible at upper right. Credit: ESA/Rosetta/Philae/ROLIS/DLR

With just 12 days before Comet 67P/Churyumov-Gerasimenko reaches perihelion, we get a look at recent images and results released by the European Space Agency from the Philae lander along with spectacular 3D photos from Rosetta's high resolution camera.

Remarkably, some 80% of the first science sequence was completed in the 64 hours before Philae fell into hibernation. Although unintentional, the failed landing attempt led to the unexpected bonus of getting data from two collection sites—the planned touchdown at Agilkia and its current precarious location at Abydos.

After first touching down, Philae was able to use its gas-sniffing Ptolemy and COSAC instruments to determine the makeup of the comet's atmosphere and surface materials. COSAC analyzed samples that entered tubes at the bottom of the lander and found ice-poor dust grains that were rich in organic compounds containing carbon and nitrogen. It found 16 in all including methyl isocyanate, acetone, propionaldehyde and acetamide that had never been seen in comets before.

While you and I may not be familiar with some of these organics, their complexity hints that even in the deep cold and radiation-saturated no man's land of outer space, a rich assortment of organic materials can evolve. Colliding with Earth during its early history, comets may have delivered chemicals essential for the evolution of life.

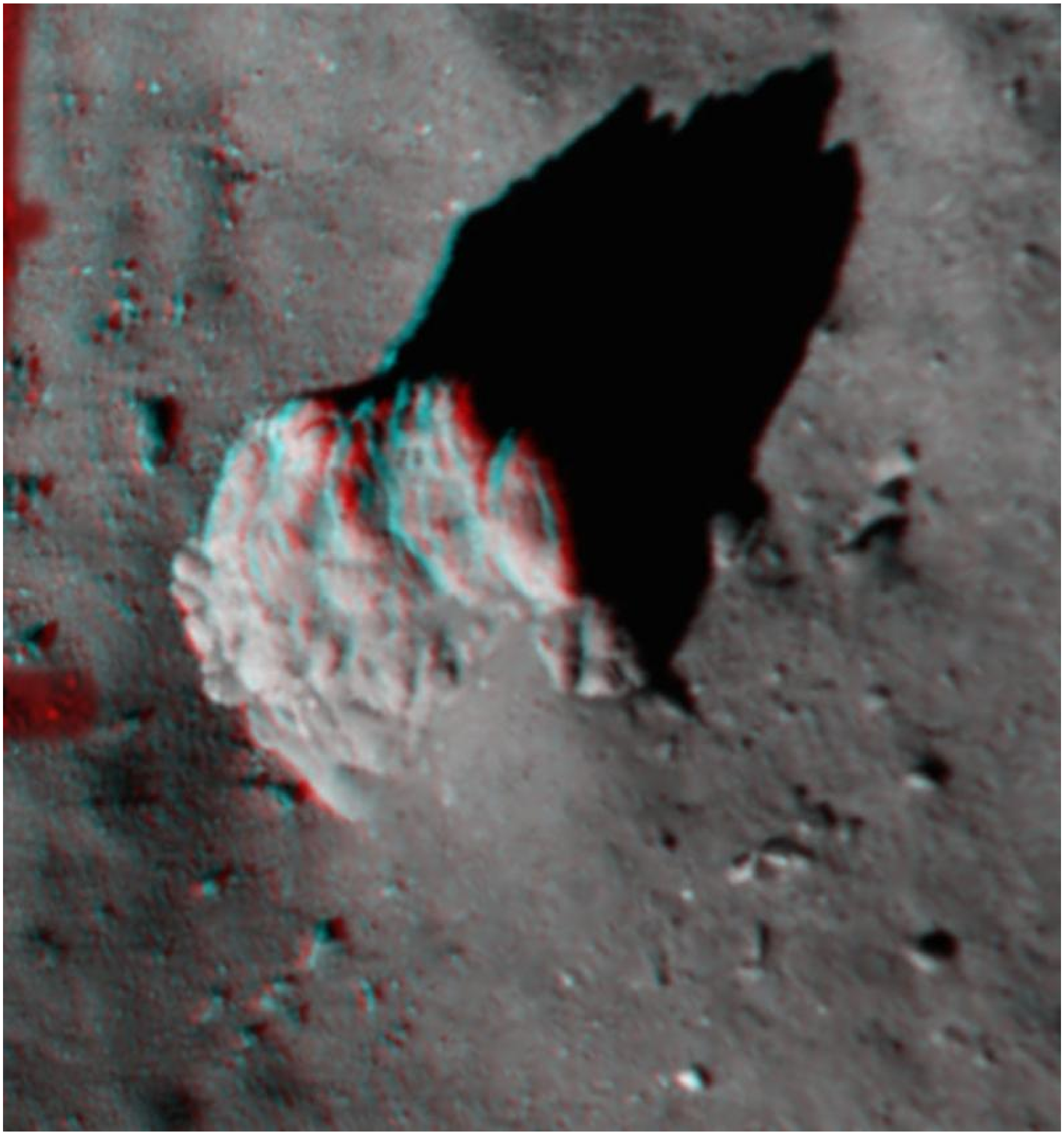

Slow animation of images taken by Philae's Rosetta Lander Imaging System, ROLIS, trace the lander's descent to the first landing site, Agilkia, on Comet 67P/Churyumov–Gerasimenko on November 12, 2014. Credits: ESA/Rosetta/Philae/ROLIS/DLR

Ptolemy sampled the atmosphere entering tubes at the top of the lander and identified water vapor, carbon monoxide and carbon dioxide, along with smaller amounts of carbon-bearing organic compounds, including formaldehyde. Some of these juicy organic delights have long been thought to have played a role in life's origins. Formaldehyde reacts with other commonly available materials to form complex sugars like ribose which forms the backbone of RNA and is related to the sugar deoxyribose, the "D" in DNA.

ROLIS (Rosetta Lander Imaging System) images taken shortly before the first touchdown revealed a surface of 3-foot-wide (meter-size) irregular-shaped blocks and coarse "soil" or regolith covered in "pebbles" 4-20 inches (10–50 cm) across as well as a mix of smaller debris.

Agilkia's regolith, the name given to the rocky soil of other planets, moons, comets and asteroids, is thought to extend to a depth of about 6 feet (2 meters) in places, but seems to be free from fine-grained dust deposits at the resolution of the images. The 16-foot-high boulder in the photo above has been heavily fractured by some type of erosional process, possibly a heating and cooling cycle that vaporized a portion of its ice. Dust from elsewhere on the comet has been transported to the boulder's base. This appears to happen over much of 67P/C-G as jets shoot gas and dust into the coma, some of which then settles out across the comet's surface.

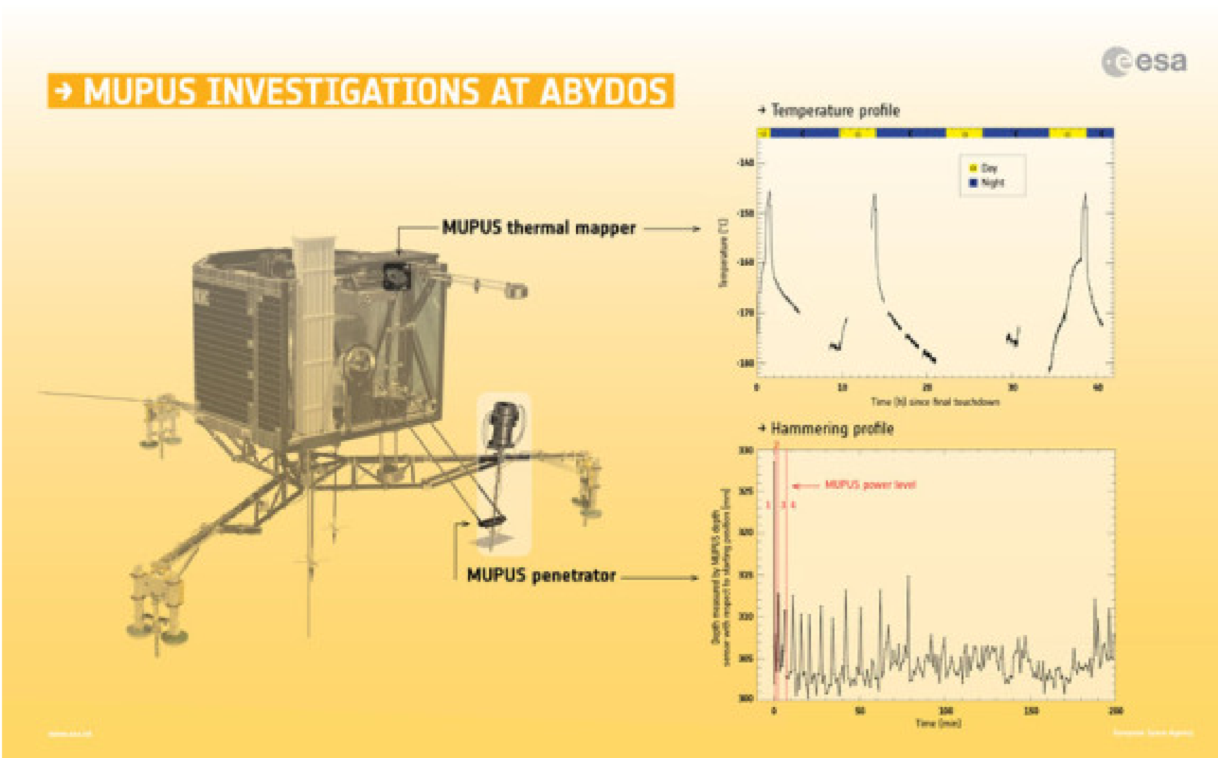
Another suite of instruments called MUPUS used a penetrating "hammer" to reveal a thin layer of dust about an inch thick (~ 3 cm) overlying a much harder, compacted mixture of dust and ice at Abydos. The thermal sensor took the comet's daily temperature which varies from a high around –229° F (–145ºC) to a nighttime low of about –292° F (–180ºC), in sync with the comet's 12.4 hour day. The rate at which the temperature rises and falls also indicates a thin layer of dust rests atop a compacted dust-ice crust.



This 3D image focuses on the largest boulder seen in the image captured 221 feet (67.4 m) above Comet 67P/Churyumov–Gerasimenko looks best in a pair of red-blue 3D glasses. Many fractures, along with a tapered 'tail' of debris and excavated 'moat' around the 5 m-high boulder, are plain to see. Credit: ESA/Rosetta/Philae/ROLIS/DLR

CONSERT, which passed radio waves through the nucleus between the lander and the orbiter, showed that the small lobe of the comet is a very loosely compacted mixture of dust and ice with a porosity of 75-85%, about that of lightly compacted snow. CONSERT was also used to help triangulate Philae's location on the surface, nailing it down to an area just 69 x 112 feet ( 21 x 34 m) wide.

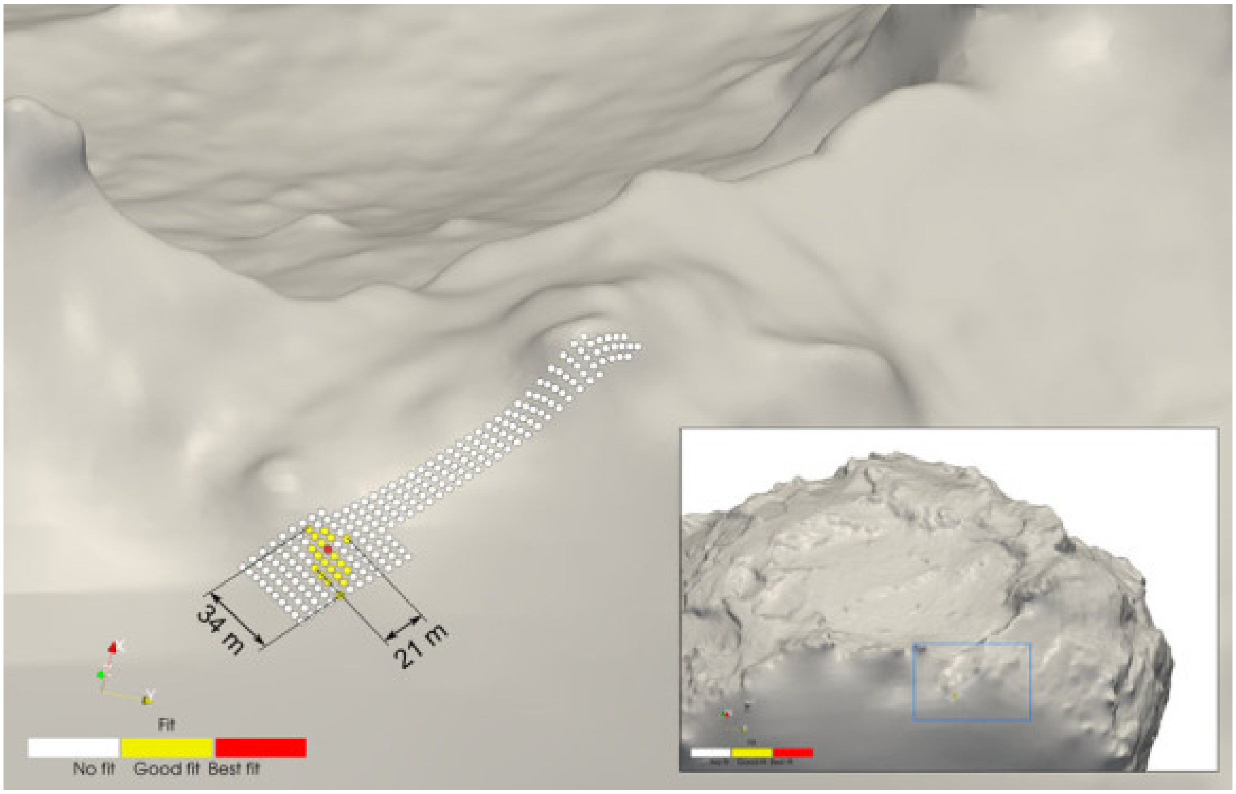
In fewer than two weeks, the comet will reach perihelion, its closest approach to the Sun at 116 million miles (186 million km), and the time when it will be most active. Rosetta will continue to monitor 67P C-G from a safe distance to lessen the chance an errant chunk of comet ice or dust might damage its instruments. Otherwise it's business as usual. Activity will gradually decline after perihelion with Rosetta providing a ringside seat throughout. The best time for viewing the comet from Earth will be mid-month when the Moon is out of the morning sky. Watch for an article with maps and directions soon.



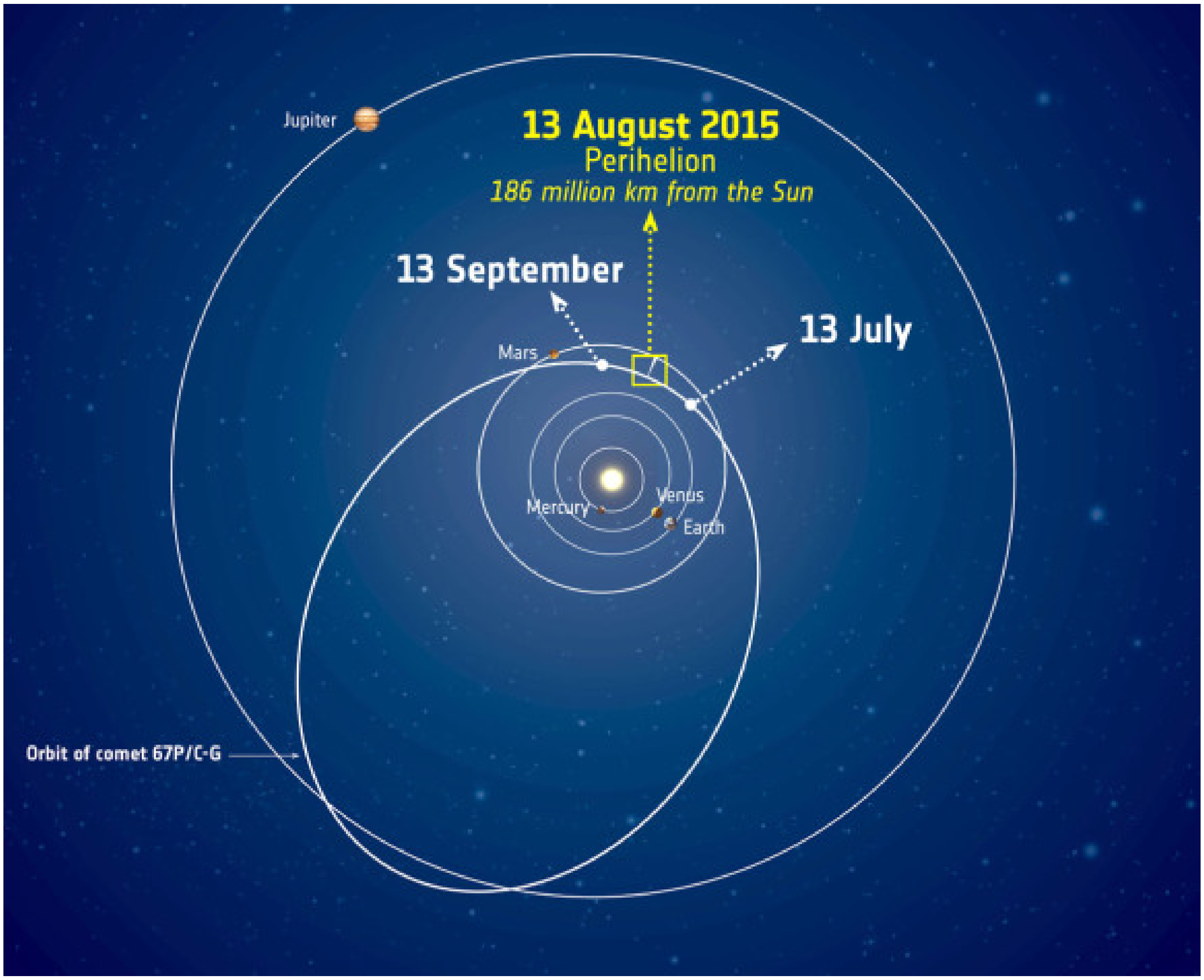
Philae used its thermal sensor to measure daily highs and lows on the comet (top graph). The bottom graph shows time vs. depth when Philae used its penetrator to hammer into the soil. Credit: Spacecraft graphic: ESA/ATG medialab; data from Spohn et al (2015)

"With perihelion fast approaching, we are busy monitoring the comet's activity from a safe distance and looking for any changes in the surface features, and we hope that Philae will be able to send us complementary reports from its location on the surface," said Philae lander manager Stephan Ulamec.

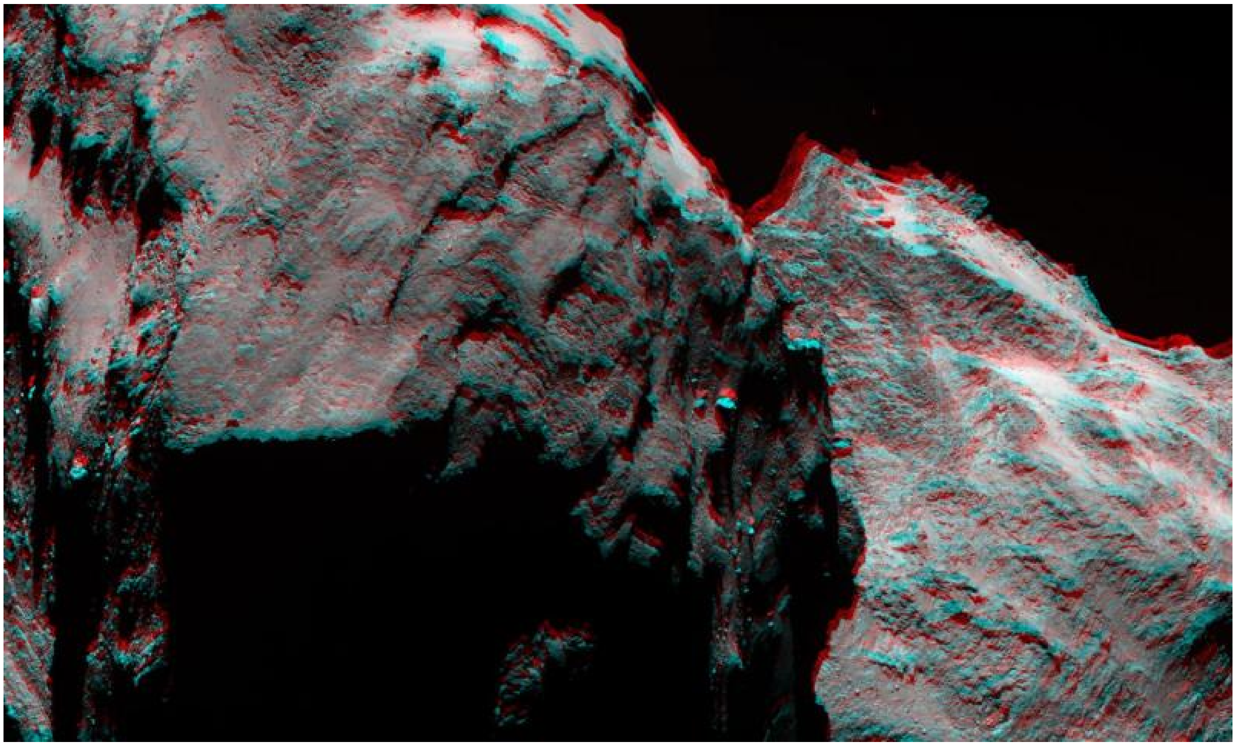
More about Philae's findings can be found in the July 31 issue of Science. Before signing off, here are a few detailed, 3D images made with the high-resolution OSIRIS camera on Rosetta. Once you don a pair of red-blue glasses, click the photos for the high-res versions and get your mind blown.




Based on the most recent calculations using CONSERT data and detailed comet shape models, Philae's location has been revised to an area covering 69 x 112 feet (21 x 34 m). The best fit area is marked in red, a good fit is marked in yellow, with areas on the white strip corresponding to previous estimates now discounted. Credit: ESA/Rosetta/Philae/CONSERT




The orbit of Comet 67P/Churyumov–Gerasimenko and its approximate location around perihelion, the closest the comet gets to the Sun. The positions of the planets are correct for August 13, 2015. The comet will pass closest to Earth in February 2016 at 135.6 million miles but will be brightest this month right around perihelion. Credit: ESA



Mosaic of two images showing an oblique view of the Atum region and its contact with Apis, the flat region in the foreground. This region is rough and pitted, with very few boulders.Credits: ESA/Rosetta/MPS for OSIRIS Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA

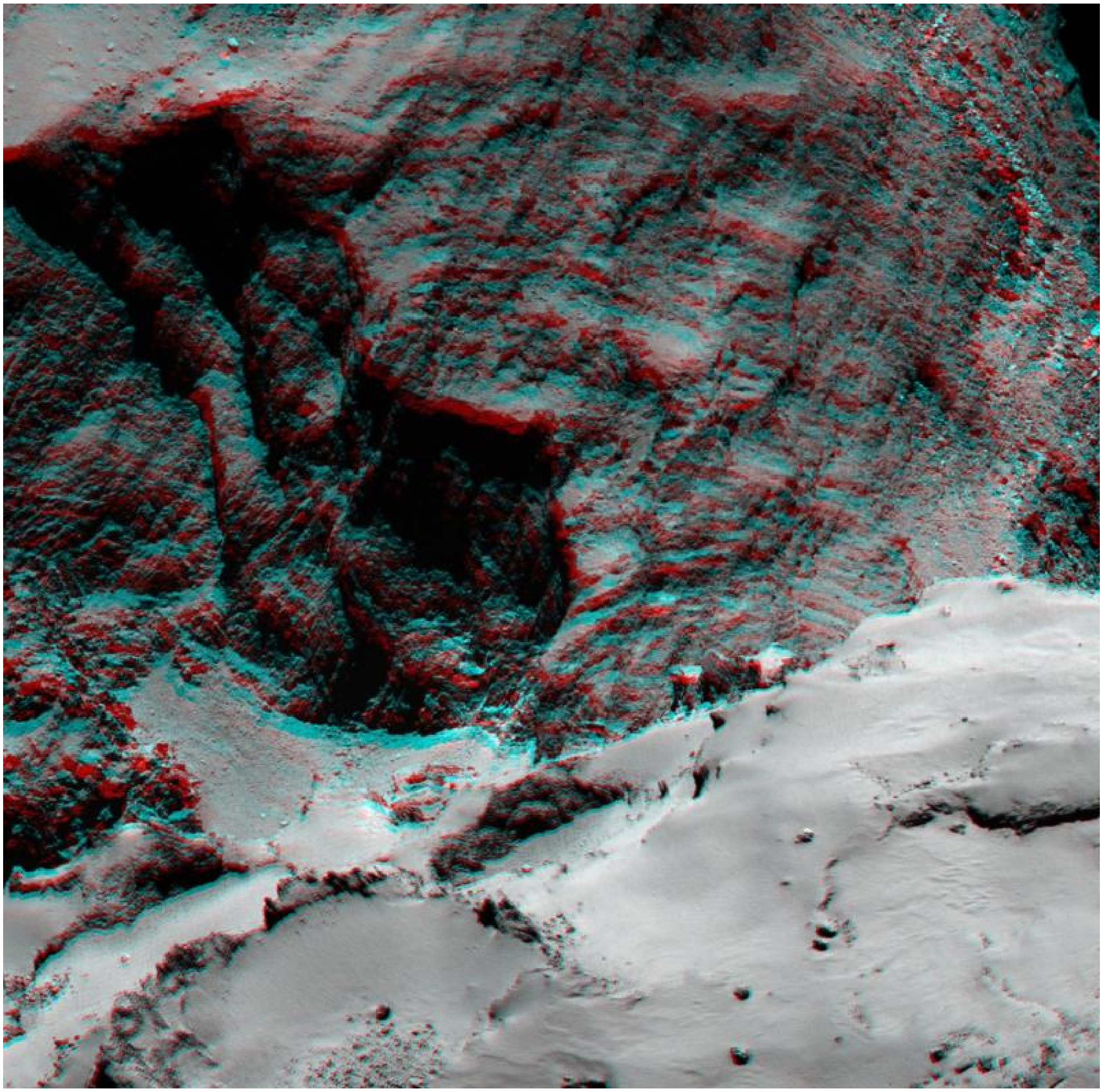
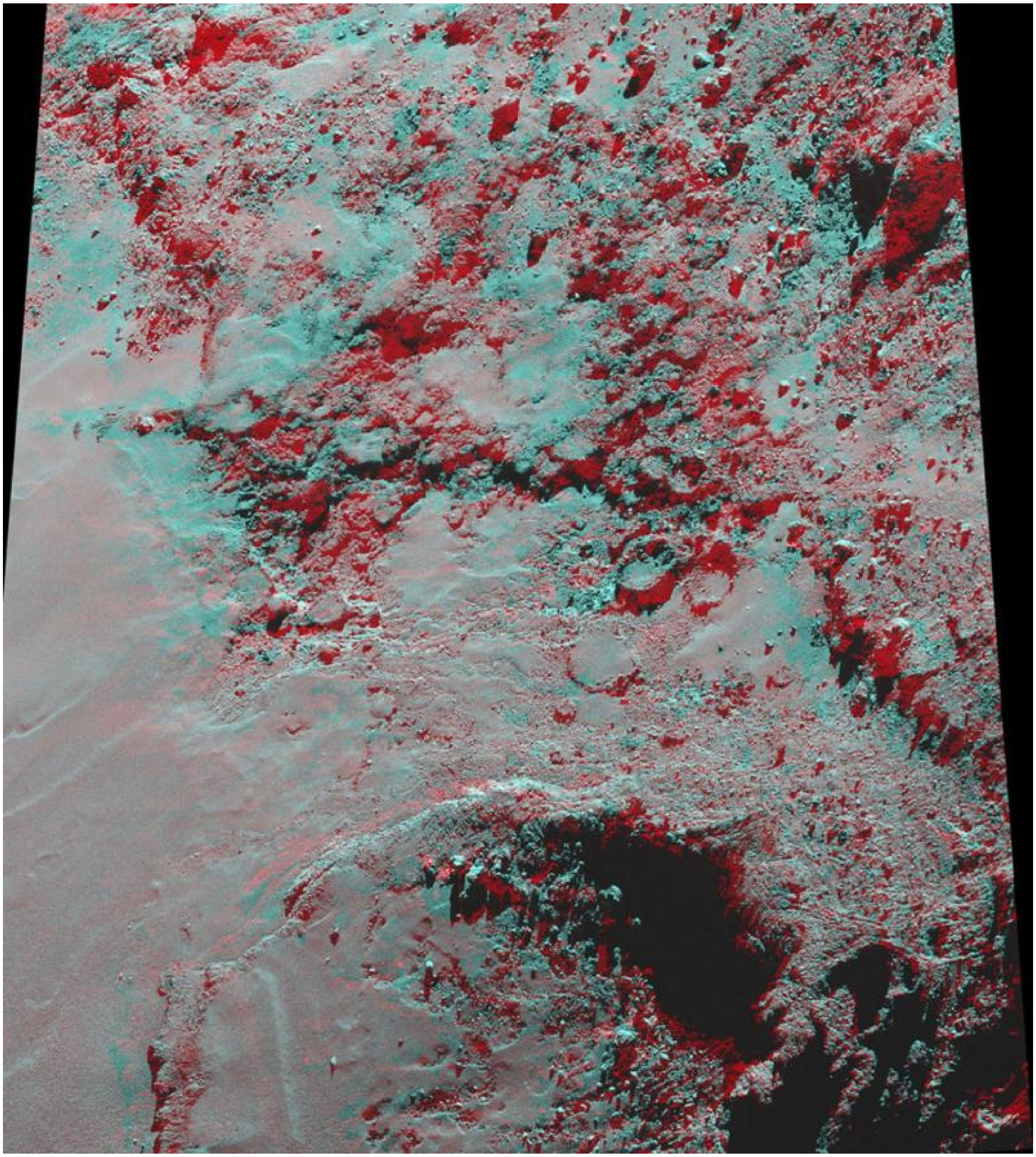


Image highlighting an alcove structure at the Hathor-Anuket boundary on the comet's small lobe. The layering seen in the alcove could be indicative of the internal structure of the comet. Credits: ESA/Rosetta/MPS for OSIRIS Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA



Imhotep region in 3D. Credit: ESA/Rosetta/MPS for OSIRIS Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA