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Mars Express closes in on the origin of Mars' larger moon

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Phobos (Animation: DLR)

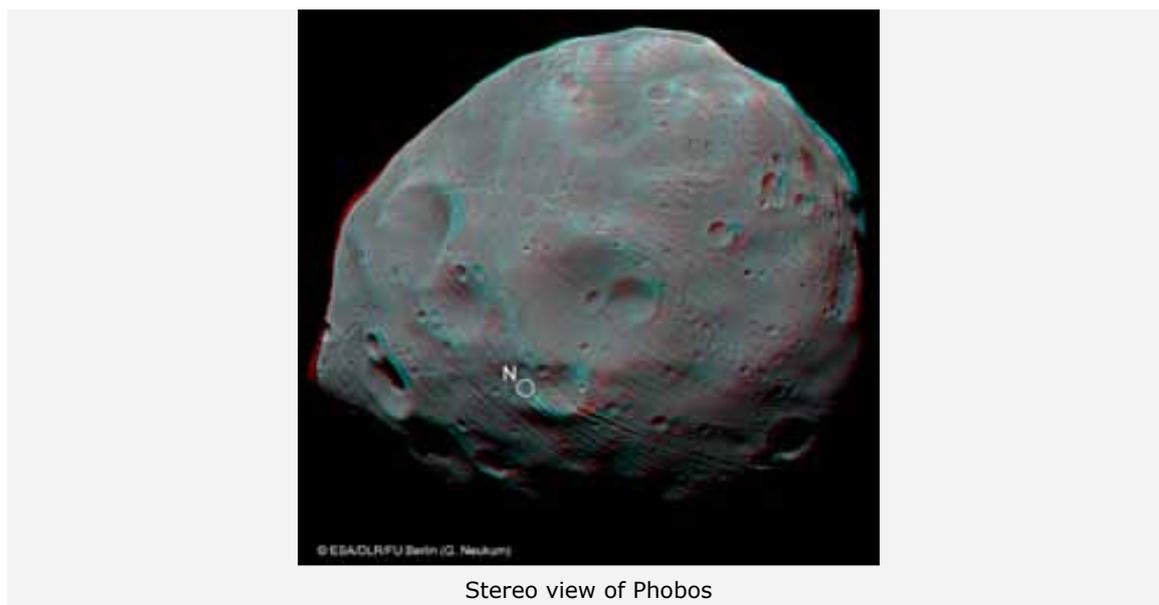
European space scientists are getting closer to unravel the origin of Mars' larger moon, Phobos. Thanks to a series of close encounters by ESA's Mars Express spacecraft and images captured by the High Resolution Stereo Camera (HRSC), operated by the German Aerospace Center (DLR), the moon looks almost certain to be a 'rubble pile', rather than a single solid object. However, mysteries remain about where the rubble came from.

Unlike Earth, with its single large moon, Mars plays host to two small moons. The larger one is Phobos, an irregularly sized lump of space rock measuring just 27 km x 22 km x 19 km.

During the Summer, Mars Express made a series of close passes to Phobos. It captured images at almost all flybys with the High Resolution Stereo Camera (HRSC). A team led by Gerhard Neukum, Freie Universität Berlin, is now using these and previously collected data to construct a more accurate 3D model of Phobos, so that its volume can be determined with more precision.

With data collected from the Mars Express Radio Science (MaRS) Experiment, DLR scientists from the DLR Institute of Planetary Research in Berlin are putting the mass and volume data together, to be able to calculate the density. Eventually, this will be a new important clue to how the moon formed.

The team's current mass estimate for Phobos is $1.072 \cdot 10^{16}$ kg, or about one billionth the mass of the Earth.



Stereo view of Phobos

Preliminary density calculations suggest that it is just 1.85 grams per cubic centimetre. This is lower than the density of the Martian surface rocks, which are 2.7-3.3 grams per cubic centimetre, but very similar to that of some asteroids.

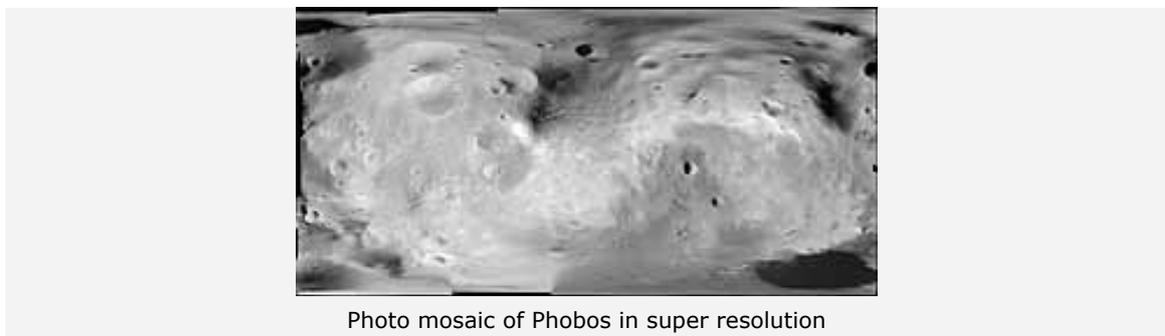
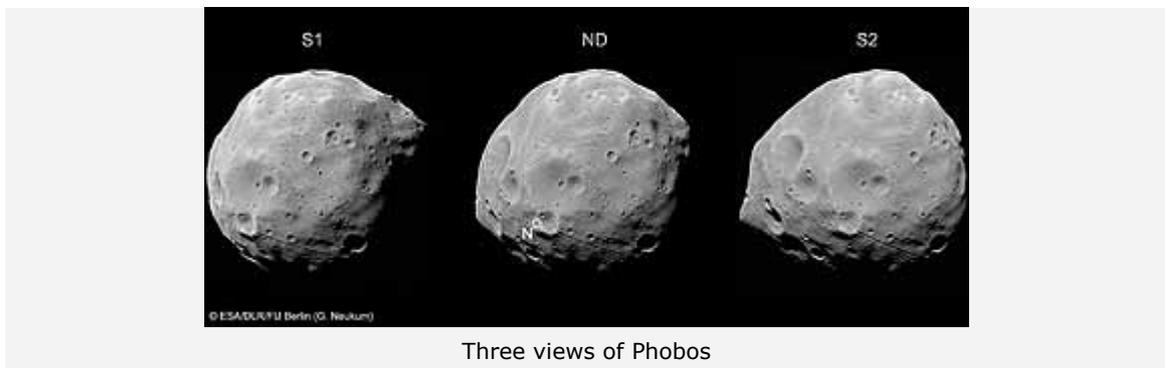
The particular class of asteroids that share Phobos's density are known as D-class. They are believed to be highly fractured bodies containing giant caverns because they are not solid. Instead, they are a collection of pieces, held together by gravity. Scientists call them rubble piles.

Also, spectroscopic data from Mars Express and previous spacecrafts show that Phobos has a similar composition to these asteroids. This suggests that Phobos, and probably its smaller sibling Deimos, are captured asteroids. However, one observation remains difficult to explain in this scenario.

Usually captured asteroids are injected into random orbits around the planet that gravitationally tie them, but Phobos orbits above Mars' equator - a very specific case. Scientists do not yet understand how it could do this.

In another scenario, Phobos could have been made of Martian rocks that were blasted into space during a large meteorite impact. These pieces have not fallen completely together, thus creating the rubble pile.

So the question remains, where did the original material come from - Mars's surface or the asteroid belt? The MARSIS radar on board Mars Express has also collected historic data about Phobos's subsurface. This data, together with that from the moon's surface and surroundings gathered by the other Mars Express instruments, will also help put constraints on the origin. It's clear though that the whole truth will only be known when samples of the moon are brought back to Earth for analysis in laboratories.



This exciting possibility might soon become reality because the Russians will attempt to do this with the Phobos-Grunt mission, to be launched next year. To land on Phobos, they will require the precise knowledge of the mass as measured by the MaRS Experiment in order to navigate correctly, and are also making use of the HRSC images to select the landing site.

The High Resolution Stereo Camera (HRSC) experiment on the ESA Mars Express Mission is led by the Principal Investigator (PI) Prof. Dr. Gerhard Neukum who also designed the camera technically. The science team of the experiment consists of 45 Co-Investigators from 32 institutions and 10 nations. The camera was developed at the German Aerospace Center (DLR) under the leadership of the PI G. Neukum and built in cooperation with industrial partners (EADS Astrium, Lewicki Microelectronic GmbH and Jena-Optronik GmbH). The experiment on Mars Express is operated by the DLR Institute of Planetary Research, through ESA/ESOC. The systematic processing of the HRSC image data is carried out at DLR. The scenes shown here were processed by the PI-group at the Institute for Geosciences of the Freie Universitaet Berlin in cooperation with the German Aerospace Center (DLR), Institute of Planetary Research, Berlin.

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