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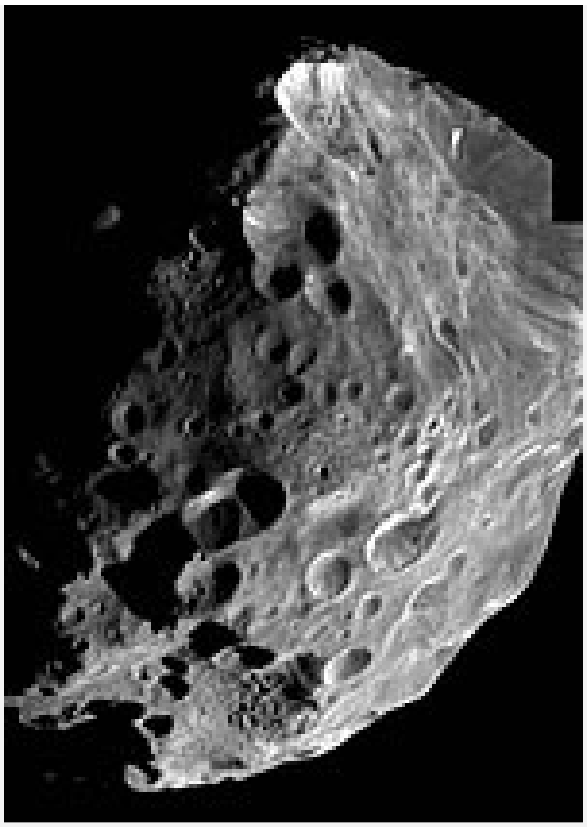
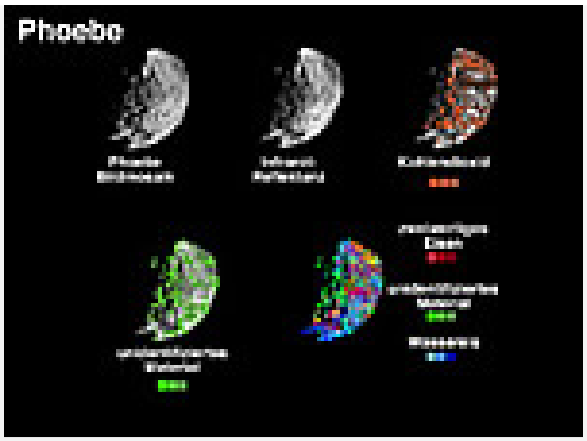
Saturn’s moon Phoebe: new discoveries

05/04/2005



Saturn's moon, Phoebe

Saturn’s moon Phoebe, just 212km across, has more chemical elements and molecules than previously thought. This is the outcome of an analysis of spectrometer data gathered from Phoebe by the American space probe Cassini. One of the scientists involved in the study, which appeared in the journal *Nature* on 5 May 2005, was planetary geologist Dr. Ralf Jaumann from the Institute for Planetary Research at the German Aerospace Center (DLR). The researchers believe that the composition of Phoebe lends weight to the theory that this small moon orbiting Saturn was not formed together with the ringed planet, but has its origins further out in the Solar System, in what is known as the ‘Kuiper Belt’ between Neptune and Pluto. It may then have been captured at a later point in time, being drawn in by Saturn’s gravitational force.

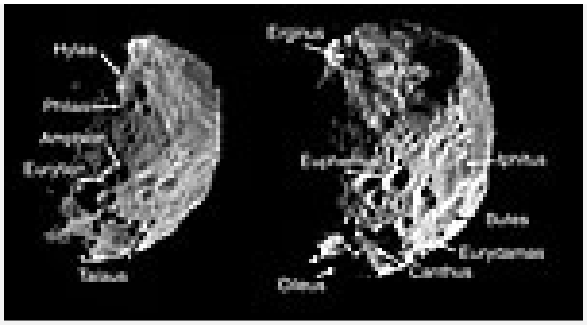


VIMS Spectrometer analysis of Phoebe

"The VIMS data show that the surface of Phoebe consists primarily of water ice, mixed with carbon dioxide, hydrated minerals (which are found on Earth in clay, for example) and a few other compounds which have yet to be identified," explains Dr. Ralf Jaumann, a member of the VIMS team, who was responsible for many of the studies carried out at the VIMS centre in Tucson, Arizona. "In the spectra we also see traces of primitive organic compounds, in other words: hydrocarbon molecules." The surface composition bears few similarities to the asteroids found between Mars and Jupiter. Instead, the material that makes up Phoebe was formed far out in the Solar System. Here, it is so cold that these chemical compounds made up of volatile elements are generally stable."

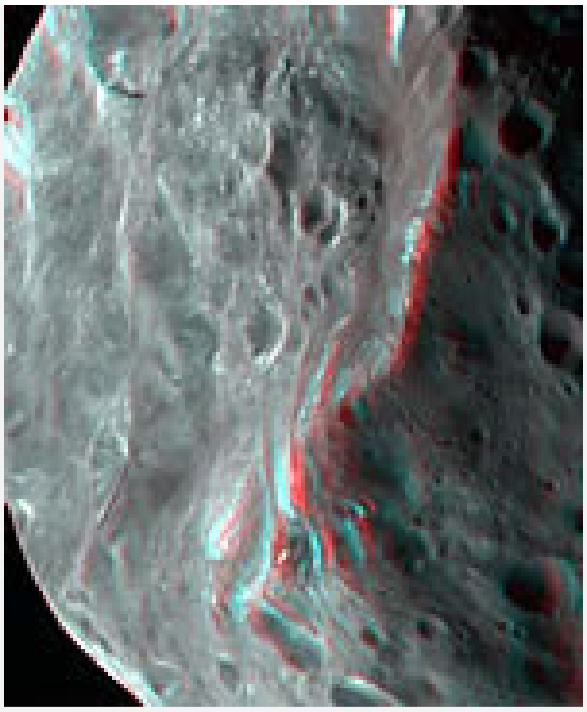
"One of the first surprises revealed by the Cassini mission was the discovery of the chemical similarity between the surface materials of Phoebe and those of comets. This demonstrates that Phoebe most probably originates in the outer Solar System, presumably in the Kuiper Belt, and not in the asteroid belt. This means that Phoebe belongs to some of the very oldest material in the Solar System," says Robert Brown, the head of the VIMS team at the university in Tucson. Phoebe's outermost crust of rock and dust is estimated to be no more than a few hundred metres thick, beneath which the small moon consists mainly of water ice. The surface is four billion years old or more.

The US/European planetary mission Cassini-Huygens completed its long journey to Saturn after almost seven years, having travelled three and a half billion kilometres. On 1 July 2004, it swung into orbit around the second largest planet in the Solar System. On its approach to the ringed planet, on 11 June 2004, the spacecraft made its first, almost direct 'contact' with one of Saturn's outer moons, Phoebe, with an average diameter of just 212km. In Greek mythology, Phoebe was the daughter of the Titan goddess Uranus. The spacecraft passed by Phoebe at a distance of just 2068km, providing the twelve scientific instruments on board Cassini some unique opportunities for observation. Images of Phoebe show a satellite pitted with craters, a body whose geological formation and chemical-mineralogical composition now appear to be much more complex than previously suspected.



Saturn's moon Phoebe: Mosaic picture with crater names

The Cassini spectrometer team, including Dr. Ralf Jaumann from the DLR's Institute for Planetary Research in Berlin-Adlershof, studied the data gathered by the VIMS (Visible and Infrared Mapping Spectrometer) immediately after the fly-by of Phoebe at the University of Arizona in Tucson, USA. This instrument is able to break down the electromagnetic radiation reflected from the surface in the wavelengths of visible light and near and medium infrared in such a way that reasonably accurate conclusions can be drawn about the chemical elements and molecules on the surface using diagnostic 'absorption bands'.



Phoebe's largest crater in 3-D

VIMS can map a surface in 352 colours simultaneously, from visible light far into the infrared part of the spectrum. All materials reflect light in a unique way. This means that we can identify molecules and compounds by the characteristic colours they reflect or absorb. This was what enabled the VIMS team to establish the composition of Phoebe in just a few days after the fly-by. The VIMS team is made up of scientists from the USA, Germany, France and Italy and the VIMS centre is located at the University of Arizona in Tucson, Arizona.

Scientists have long suspected that Phoebe did not form in the same location and from the same material as Saturn and most of its moons. Phoebe follows a very unusual orbital path around Saturn, with its axis of rotation at a sharp angle relative to Saturn's equator. Phoebe rotates in the opposite direction to Saturn and to the direction of rotation described by the planet around the Sun. In its orbit around Saturn, Phoebe also moves in the opposite direction to the other moons. But if Phoebe was not formed in the Saturn system, where did it come from? 'Short period' comets (comets that take less than two hundred years to orbit around the Sun) can be found together with other primitive material from the time when the solar system was being formed far beyond the orbital path of Neptune, and can be flung into the inner solar system by Neptune's gravitational force. This is how Phoebe, so far from the Sun, came so close to Saturn that it was captured by the planet's gravitational force and pulled into its unusual orbit. This hypothesis, which was published in the same edition of *Nature*, is supported by the calculations done by two American authors on the thickness and volume of Phoebe.

Die zitierte Veröffentlichung:

Compositional Maps of Saturn's moon Phoebe from imaging spectroscopy. Roger N. Clark, Robert H. Brown, Ralf Jaumann and others, in: Nature, Vol. 435, Pages 66-69.

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