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DLR researchers compile atlas of Saturn's moon Rhea, an icy alien world

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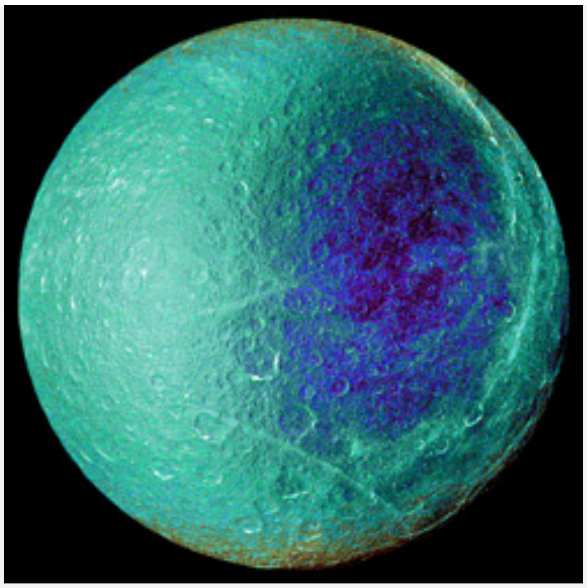
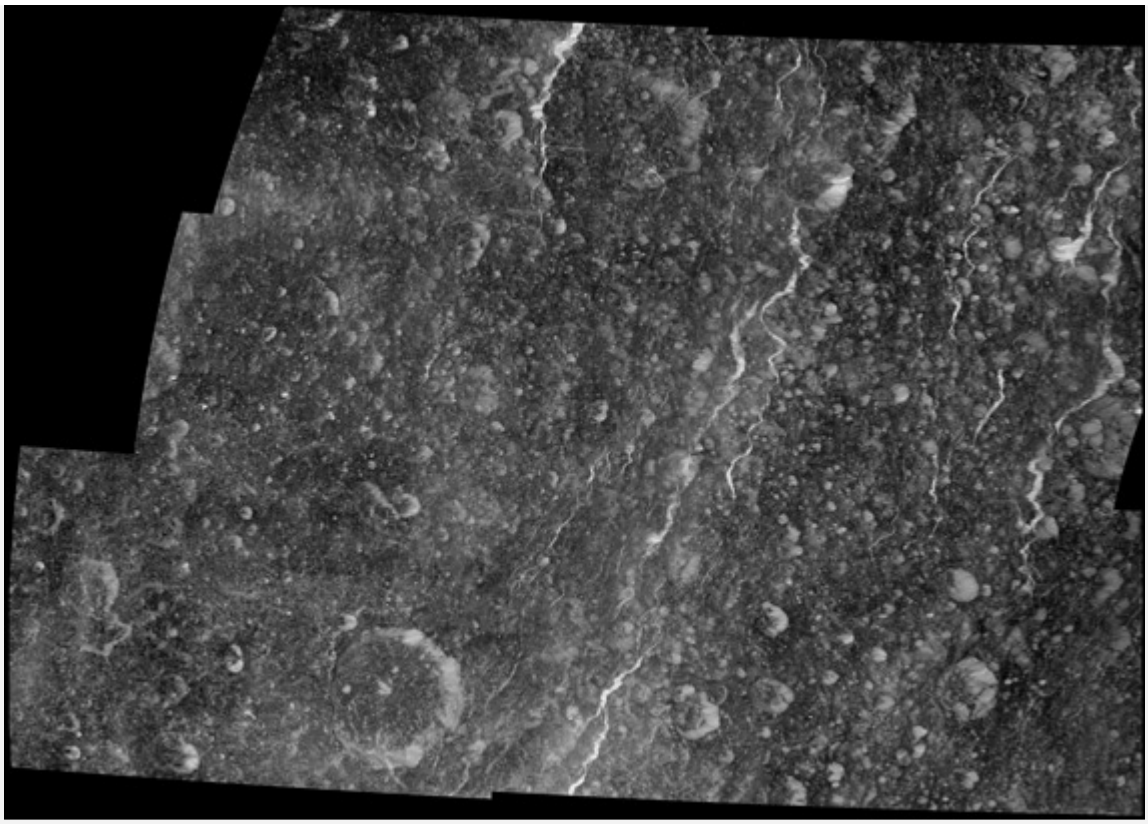


Rhea in false colour

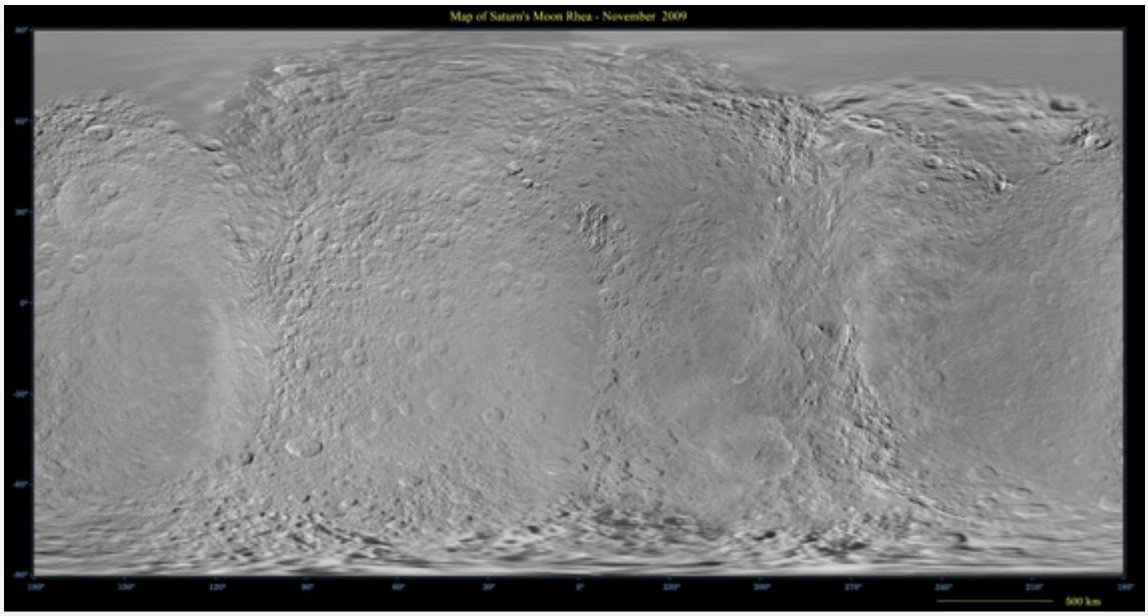
Researchers at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) have compiled an atlas of Saturn's second largest moon, Rhea, which has been published by NASA today. The atlas includes a number of high-resolution images and a three-dimensional view of fractures on the icy world acquired by the Cassini spacecraft, which has been orbiting Saturn for six and a half years. The data was obtained during two fly-bys in September 2009 and March 2010, from distances as close as 100 kilometres. The atlas comprises the most detailed images of Rhea to date and provides an insight into the geological development and surface composition of the moon. Recently, two instruments on Cassini discovered a thin oxygen-carbon dioxide atmosphere, or exosphere, on Rhea.

Fractures in the brittle ice, with temperatures as low as minus 200 degrees Celsius



Rhea's western wisps

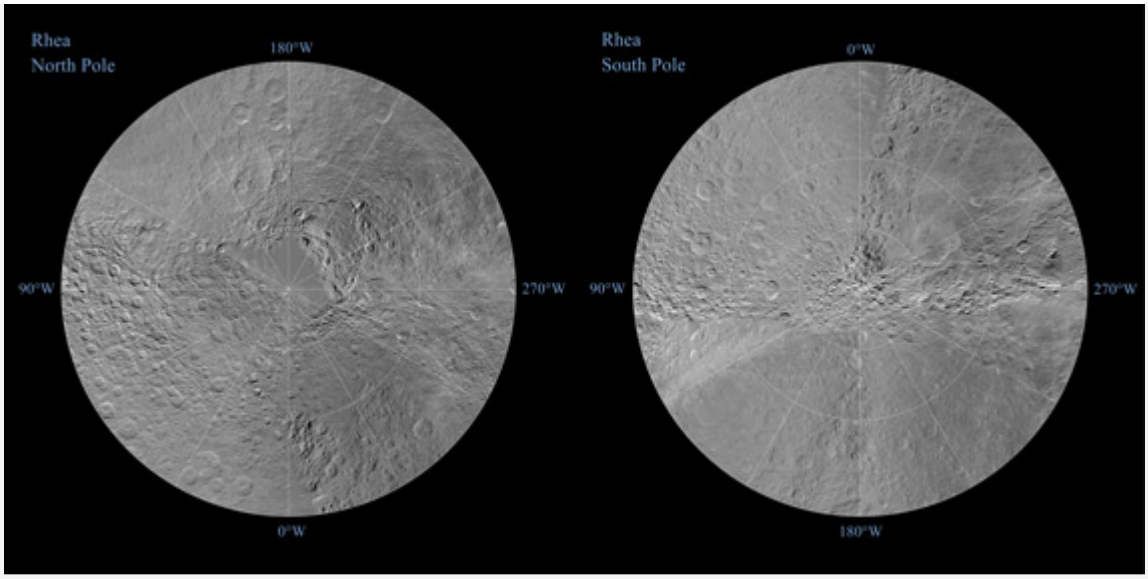
Of particular interest are a number of long, usually linear structures over 100 kilometres long, that are winding in some places. The origin of these thin lines was a mystery for a long time. "The high-resolution image data from Cassini was the first to reveal that the bright lines are actually tectonic in origin, meaning that they are fractures in the ice crust, created during sudden releases of crustal stress," explains Roland Wagner from the DLR Institute of Planetary Research (Institut für Planetenforschung; IPF). They may have arisen during periods of extensional and shearing tectonic activity. "By correlating the high-resolution images with spectroscopic data, we found that the conspicuous brightness of these lines is caused by the exposure of almost pure water ice on the escarpments of these tectonic structures," explains the planetary geologist. The tectonic graben on Rhea are up to four kilometres deep. "This means that there must have been an enormous amount of stress in the brittle crust of the Moon in the past," adds Wagner. "We can only speculate as to the cause of the stress."



Global map of Rhea

Rhea has a diameter of 1528 kilometres and orbits Saturn at more than 500,000 kilometres from the planet's centre. With an average density of 1.23 grams per cubic centimetre (a little denser than water, but less than a quarter of Earth's mean density), it appears that Rhea is a largely homogeneous body consisting of two-thirds water ice and one-third rock. With these latest observations, it is evident that Rhea is a cousin of Dione, the adjacent Saturnian moon, given the similar nature of their surfaces. These two moons, are almost like twins, similar even under their icy crust in many ways.

Regional differences in the composition of the surface

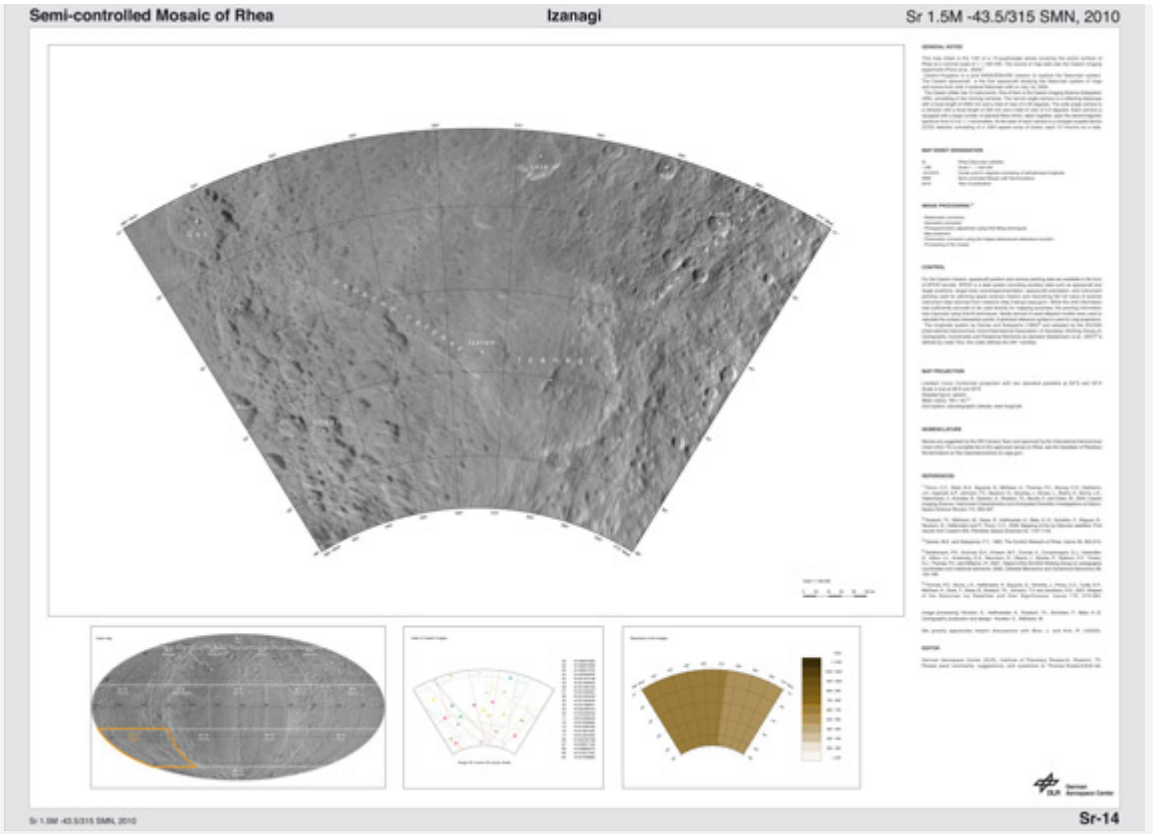


Polar map of Rhea

Like Earth's Moon, Rhea orbits in 'synchronous rotation', meaning that it rotates on its axis exactly once as it orbits the planet. Hence, the same side always faces Saturn. By combining images of the side of Rhea facing Saturn taken through three filters (ultraviolet, green and infrared), Tilman Denk of the Free University of Berlin has been able to demonstrate that on the hemisphere of the moon that faces Saturn, there are distinctive colour and brightness differences between the quarter of the surface of Rhea facing in the direction of orbital motion, and the quarter of its surface facing opposite the direction of orbital motion. Such surface differences are not unusual on icy moons with synchronous rotation in the outer Solar System. They are presumed to be the result of regional differences in the composition of the surface or differences in the size and mechanical structure of the ice grains that form the crust. Such changes can be caused by numerous processes, such as a preferred direction of incidence for

incoming microparticles or meteoritic fragments, or the penetration of ions that are trapped in Saturn's magnetic field.

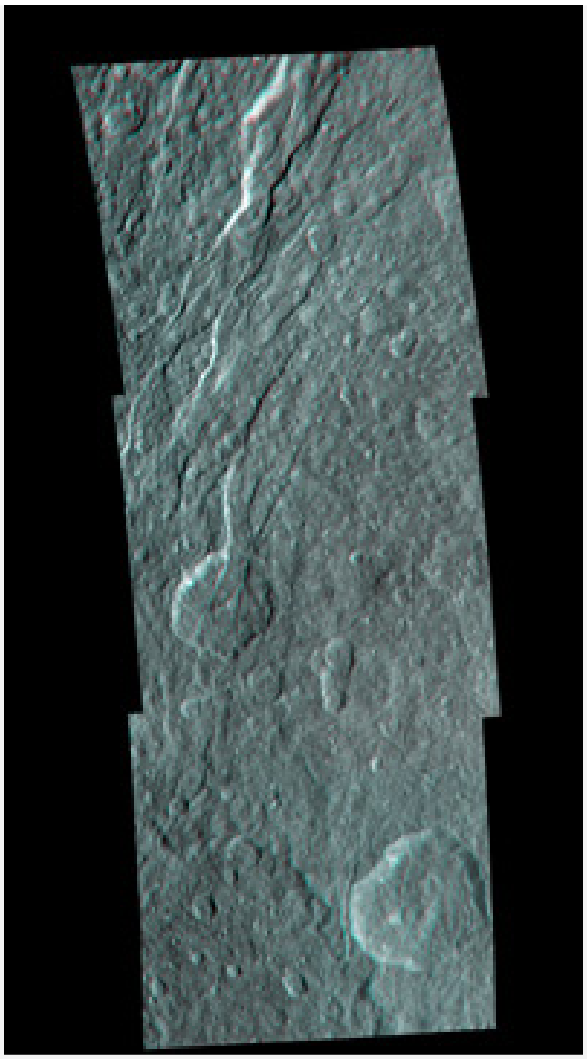
30 years after Voyager 1 – a complete map of the large Saturnian ice moon



The Rhea atlas

Voyager 1 flew by Saturn 30 years ago, on 12 November 1980. The spacecraft's images and measurements provided the first comprehensive insight into the ringed planet and its numerous moons. The two Voyager probes – Voyager 2 reached Saturn in August 1981 – revolutionised our view of the icy worlds of the outer Solar System.

This is even more true for Cassini, which has been in orbit around Saturn since mid-2004. Its Imaging Science Subsystem, ISS, is equipped with wide- and narrow-angle cameras and its experiment team is led by Carolyn Porco of the University of Colorado at Boulder, in the USA. Thomas Roatsch, from the DLR IPF, is the Associate Scientist in the science team responsible for the compilation of atlases for the seven largest moons of Saturn after Titan. "Following the atlases of Phoebe, Mimas, Enceladus, Tethys, Dione and Iapetus, we have now mapped Rhea in full and are able to reproduce its entire surface in an atlas of 15 map sheets," Roatsch explains. The International Astronomical Union has already adopted proposals for naming the craters and fractures on Rhea, using names derived from characters and places in creation myths and with an emphasis on Asian nations.



Rhea's fractured terrain in three dimensions

The camera system has taken a total of 4,386 images of Rhea over the past six years, with resolution ranging from 500 metres per pixel to 6.5 metres per pixel. For the current mapping project, 370 high-resolution images from the two close fly-bys and from nine passes at greater distances were used. The 30-year-old Voyager images proved useful too. "The 11th of January 2011 will be especially exciting, when Cassini flies just 76 kilometres above the surface of Rhea," says an enthusiastic Thomas Roatsch. "These will be by far the best images we've ever had of Rhea's surface – details down to just a few metres will become recognisable."

The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. The Jet Propulsion Laboratory, JPL, manages Cassini for NASA. The Cassini orbiter was designed, developed and assembled at JPL. NASA has extended the mission until the end of 2017. The Imaging Science Subsystem team consists of scientists from the US, UK, France and Germany. It is operated from the Space Science Institute, Boulder, Colorado, and is led by Dr Carolyn Porco. Germany's financial contribution to the mission is approximately 120 million Euro. The DLR Space Agency has supported German involvement in the mission with funding from the Federal Government.

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