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Paris, le 15octobre 2014

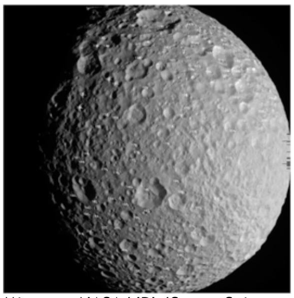
Press release

Mimas, one of Saturn's icy moons, might be hiding a highly flattened core or an internal ocean

Research

Training

Scientific Culture



Mimas © NASA/JPL/Space Science Institute/Tajeddine *et. al* 2014

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Using data obtained by the Cassini orbiter, an international team, made up of scientists from the Paris Observatory, from the Pierre and Marie University at the IMCCE (Paris Observaotory /CNRS/UPMC/Université Lille 1) and from the AIM laboratory (CEA/CNRS/ Paris Diderot University), has measured the rotation of Mimas, one of Saturn's satellites, and has found that it has oscillations. Incompatible with the predictions of models, these oscillations suggest Mimas could have, under its icy surface, a highly flattened core or an internal ocean. This work will be published in the October 17th 2014 issue of the journal *Science*.

The rotation of Mimas was determined from images obtained by the ESA/NASA Cassini probe, using a little known technique, known as stereophotogrametry[1]. Just like the moon which turns around the Earth, Mimas is in synchronous rotation around its planet, Saturn. This means that the period of the axial rotation of the satellite is the same as its orbital period around Saturn, so that the planet always sees the same side of the satellite.

However, this average motion is modulated by oscillations, referred to as librations. The librations are caused by Saturn's gravitational torque on Mimas. Two kinds of librations have been highlighted by French scientists from the Paris Observatory's Institute for celestial mechanics and ephemeris calculations (l'Institut de mécanique céleste et de calcul des éphémérides de l'Observatoire de Paris - Observatoire de Paris/CNRS/Université Pierre et Marie Curie/Université Lille 1) and from the AIM laboratory (CEA/CNRS/Université Paris Diderot), and by scientists from the Belgian Royal Observatory, Numur University (Belgium) as well as from Cornell University (U.S.A.): a low frequency libration and a high frequency one. It turns out that of these two kinds of libration, the amplitude of the high frequency one is twice as large as the low frequency one, which is incompatible with the rotation of a solid satellite in hydrostatic equilibrium. This amplitude bears witness to the mass distribution within the body, and to the presence or absence of liquid layers.

These observations are thus surprising, and reveal a most intriguing internal structure. After having investigated various hypotheses it would seem that his strong amplitude can be explained either by the presence of an elongated core under Mimas' ice mantle, or by an internal ocean trapped between its ice covered surface and its core.

In effect, planetologists believe that Mimas' core must be in hydrostatic equilibrium (so that the gravitational, centrifugal and pressure forces balance through the body of the stallite), which implies that the satellite was formed very long ago. Now, the large amplitude of the high frequency libration could indicate that the core has an elongation of 20 to 60 km larger than in the hydrostatic case. If Mimas' core is really so elongated, it must have stayed frozen since its formation and maintained essentially its original shape. On the other hand, if Mimas has an internal ocean, it becomes a member of te solar system club of «satellites with an internal ocean» together with Titan, another satellite of Saturn, as well as various jovian satellites. Such a global ocean would be a real surprise, since the surface of Mimas carries no trace of recent geological activity.

[1] Using this technique, it is possible to find the three dimensional structure of a part of the surface of a body, providing that it has been observed at least twice from different directions. To do this, a set of control points was obtained from observation of various craters on the entire surface of the satellite, using the ISS-NAC camera on the Cassini probe. The rotation of Mimas was found by comparing the predicted positions of these control points with the actual positions determined during the various flybys of the probe.

Further observations by Cassini should lead to better models for the internal structure of Mimas.

Whichever of these two solutions turns out to be the right one, we already know that Mimas, in spite of its apparently old surface dotted with craters and its small size, is not the cold and inert body that we believed. Unravelling the mystery of its internal structure will surely lead to a better understanding of its formation, and thereby to that of the origin of the Saturnian system as a whole.

Reference :

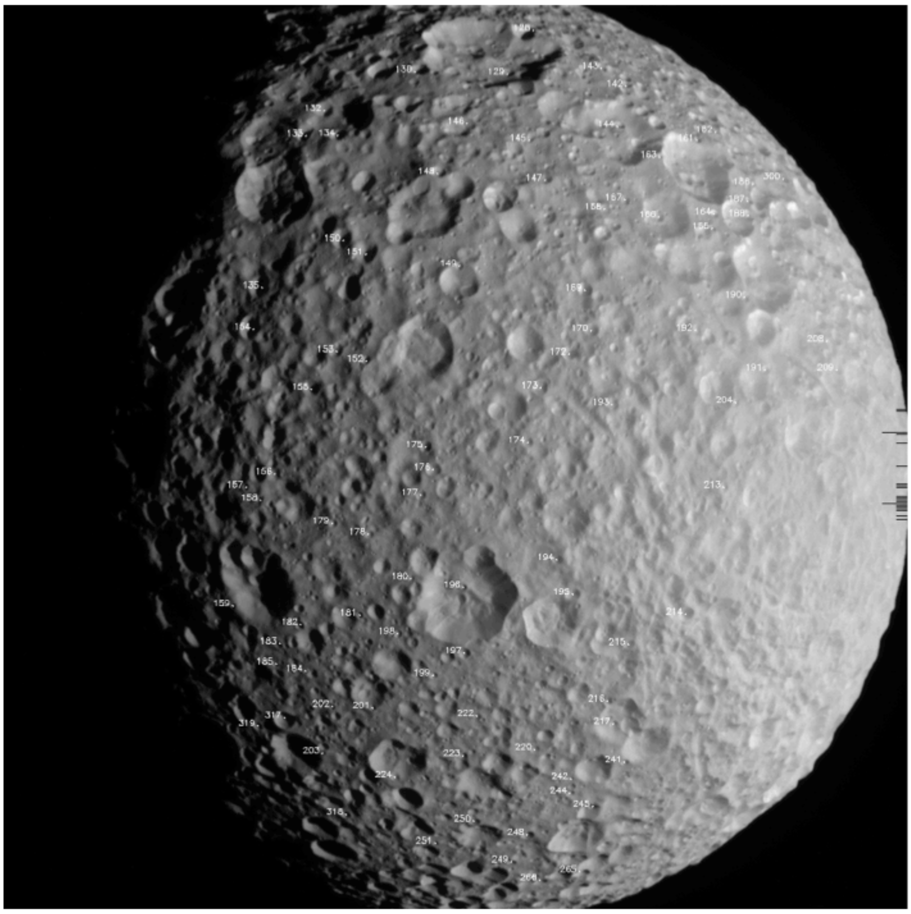
This work is the subject of a paper entitled «*Mimas' surprisinginterior: Strong constraints from Cassini ISS libration measurements*», which has appeared in the October 17, 2014 issue of *Science*.

Collaboration :

This result is the fruit of research carried out by an international team called « Encelade », financed during the period 2010 to 2013 by the Pierre and Marie Curie Univeristy - UPMC via an EMERGENCE grant, and during 2012 tp 2014 by the Paris Observatory's science counsel.

Link to the Encelade group : http://www.imcce.fr/~lainey/Encelade.htm

Picture:



Caption:

The network of control points on the surface of Mimas, from which it was possible to determine the rotational motion of the body.
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