Available online at www.sciencedirect.com
ScienceDirect
Icarus 193 (2008) 305–308
ICARUS
www.elsevier.com/locate/icarus

Introduction

The Saturn system's icy satellites: New results from Cassini

Cassini–Huygens is a multidisciplinary, international planetary mission consisting of an orbiting spacecraft and a probe. The Huygens probe successfully landed on Titan's surface on January 14, 2005, while the orbiter has performed observations of Saturn, its rings, satellites, and magnetosphere since it entered orbit around Saturn on July 1, 2004. The Cassini mission has been prolific in its scientific discoveries about the Saturn system. In this special section, we present new mission results with a focus on the "icy satellites," which we define as all Saturn's moons with the exception of Titan. The results included in this section have come out of the Cassini SOST—Satellites Orbiter Science Team—a multiinstrument and multidiscipline group that works together to better understand the icy satellites and their interactions with Saturn and its rings. Other papers included in this issue present ground-based observations and interior modeling of these icy moons.

The icy satellites of Saturn are unique worlds. They cover a range in terms of size, from 1500 km Rhea to 270 km Hyperion and even smaller "rocks." Cassini instruments are showing us in more detail how unique these worlds are. Some of the greatest surprises from Cassini data have been the volcanic activity on Enceladus (see collection of papers in Science 311, 1389–1428), the sponge-like appearance of Hyperion (Cruikshank et al., 2007; Thomas et al., 2007), and the equatorial ridge on Iapetus (Porco et al., 2005). Mimas and Tethys have impact craters caused by bodies that were nearly large enough to break the moons apart (Buratti and Thomas, 2006). Iapetus is unique in the Saturn system because of its mysterious "belly band" (Porco et al., 2005), although interestingly, a similar equatorial bulge has been observed by Ostro et al. (2006) on the 1.5-km-diameter Alpha, the primary component of the binary Asteroid (66391) 1999 KW4. While accretion of dust particles external to Iapetus may be darkening its leading side, the inner satellites may be brightened by coating from Saturn's E-ring particles (Verbiscer et al., 2007). The Saturn system offers us an unrivalled natural laboratory for understanding the interaction between a large ring system, a substantial planetary magnetosphere, and a wide range of geologically diverse satellites.

Cassini has executed several targeted flybys of icy satellites (Table 1) and more are planned for the future. In addition, there are numerous other opportunities for observations as nontargeted encounters, usually at greater distances. We have endeavored to take advantage of all available opportunities to make multiinstrument observations of these satellites. The papers in this section report results from these observations, as well as theoretical modeling.

Cassini flew within 2000 km of Phoebe on June 11, 2004, prior to Saturn orbit insertion. Phoebe is thought to be a captured Kuiper Belt or perhaps Chiron-like object (Simonelli et al., 1999; Owen et al., 1999; Clark et al., 2005), though the hypothesis that it is an errant asteroid has also been put forward (e.g., Degewij et al., 1980). Its origin is therefore important for studies of Solar System formation and evolution. Buratti et al. ("Infrared Photometry of Phoebe from the *Cassini* Visual Infrared Mapping Spectrometer") analyzed photometric data from Cassini VIMS (Visual and Infrared Spectrometer) and characterized the physical properties of the surface, including macroscopic roughness and the single particle phase function. They concluded that the surface of Phoebe is rough and dusty, perhaps from a history of outgassing. The spectral characteristics of the surface suggested that it originated outside the Saturn system, consistent with Phoebe being a captured body, perhaps from the Kuiper Belt. Hendrix and Hansen ("Ultraviolet Observations of Phoebe from *Cassini* UVIS") also address the question of Phoebe's origin using data from the Ultraviolet Imaging Spectrograph (UVIS). They present the first detection and mapping of water ice on a Solar System surface using FUV wavelengths. The ice amounts detected are consistent with the IR measurements and also support the hypothesis that Phoebe originated in the outer Solar System (at Jupiter's orbit or beyond) rather than the asteroid belt. The authors searched for but did not detect volatile emissions that would be consistent with comet-like activity such as that detected on Chiron.

Other than water ice, Phoebe's surface is rich in organics, and the composition of its surface, as well as that of Iapetus, is discussed in the paper by Cruikshank et al. ("Hydrocarbons on Saturn's Satellites Iapetus and Phoebe"), who use VIMS data to analyze the composition of the dark material on both Iapetus and Phoebe. They identify a broad absorption feature centered at 3.29 μm on the spectra of both satellites as the C-H stretching mode vibration in polycyclic aromatic hydrocarbon (PAH) molecules. These prebiotic chemicals are also found in carbonaceous meteorites, cometary dust particles, and circumstellar and interstellar dust. While there are similarities in the composition of these two bodies, there are also differences, as

0019-1035/$ – see front matter © 2007 Elsevier Inc. All rights reserved.
doi:10.1016/j.icarus.2007.11.002