MAPPING OF THE ICY SATURNIAN SATELLITES

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The Saturnian system contains 47 satellites of different sizes. This paper deals with the mapping of the so-called medium-sized icy satellites Mimas, Enceladus, Tethys, Dione, Rhea, Iapetus, and Phoebe. Voyager-1 and Voyager-2 obtained a large number of images from the icy Saturnian satellites during their journeys through the Saturnian system in 1980 and 1981. These images constitute the basis for the planning of the Cassini mission. The Cassini Imaging Science Subsystem (ISS) consists of two framing cameras. The narrow angle camera is a reflecting telescope with a focal length of 2000 mm and a field of view of 0.35 degrees. The wide angle camera is a refractor with a focal length of 200 mm and a field of view of 3.5 degrees. Each camera is outfitted with a large number of spectral filters which, taken together, span the electromagnetic spectrum from 0.2 to 1.1 micrometers. At the heart of each camera is a charged coupled device (CCD) detector consisting of a 1024 square array of pixels, each 12 microns on a side. The stated objective of the ISS is to obtain global coverage for all medium-sized icy satellites with a resolution better than 1 km/pixel and high-resolution images [Porco et al., 2004]. This goal is being achieved with image sequences obtained during close flybys supplemented by images from greater distances to complete the coverage. Close flybys of all medium sized satellites except Mimas are planned during the nominal mission of the Cassini spacecraft. The first flybys during the mission were those of Phoebe in June 2004 and Iapetus in December 2004 followed by three flybys of Enceladus in February, March, and July 2005 [Porco et al., 2005,2006] and flybys of Tethys, Dione, and Rhea in fall 2005.

Though the Cassini-ISS camera takes images using many different filters [Porco et al., 2004], we used only images taken with the filters CL1, CL2 or GRN, as these images show similar contrast. For the Cassini mission, spacecraft position and camera pointing data are available in the form of SPICE kernels [http://naif.jpl.nasa.gov]. While the orbit information is sufficiently accurate to be used directly for mapping purposes, the pointing information must be corrected using limb fits. High resolution images that do not contain the limb were registered to limb images to improve the pointing. For the Cassini maps, newly derived tri-axial ellipsoid models were used to calculate the surface intersection points. The coordinate system adopted by the Cassini mission for satellite mapping is the IAU "planetographic" system, consisting of planetographic latitude and positive west longitude. Digital maps are prepared in simple cylindrical projection, a special case of equirectangular projection. The prime meridian is in the center of the map.

Imaging of the medium-sized icy satellites is ongoing and will continue until the end of the Cassini mission, making it possible to improve the image mosaics during the tour. The starting points of global mosaics for any satellite are the Voyager mosaics in which areas can be replaced gradually by higher-resolution Cassini images as data become available. At some point in time new mosaics can be generated on the basis of Cassini image data, where Voyager data fill the gaps between the Cassini images. In these maps, the satellite coverage, as expected by the end of the nominal Cassini mission in July 2008, can be visualized. The global mosaics are usually produced using images of a similar resolution. However, some areas of the satellites are imaged at very high resolution. The data set of Phoebe is the only one that is complete, as no more high-resolution images are expected during the mission. Also, we will not obtain new high-resolution Enceladus images until 2008. Therefore standard maps were generated for these two satellites. A global mosaic and a standard map sheet of Phoebe were produced in a scale of 1:1,000,000 (see Figure 1). We produced the Phoebe mosaic from 27 narrow-angle (NA) images of the Cassini ISS camera. We used the Mercator projection within the latitude range -57° to +57° and the stereographic projections polewards beyond +/-55°, respectively. As proposed by Greeley and Batson [1990] and Kirk et al. [1998] the projections are conformal, the quadrangles overlap, and the scale of the poles was chosen such that the circumference of the stereographic projection is identical to the width of the Mercator projection. The nomenclature was proposed by the Cassini imaging team and has yet to be validated by the IAU. The resolution of the mosaic is 0.233 km/pixel, although the highest resolution images have resolutions of 0.07 km/pixel.

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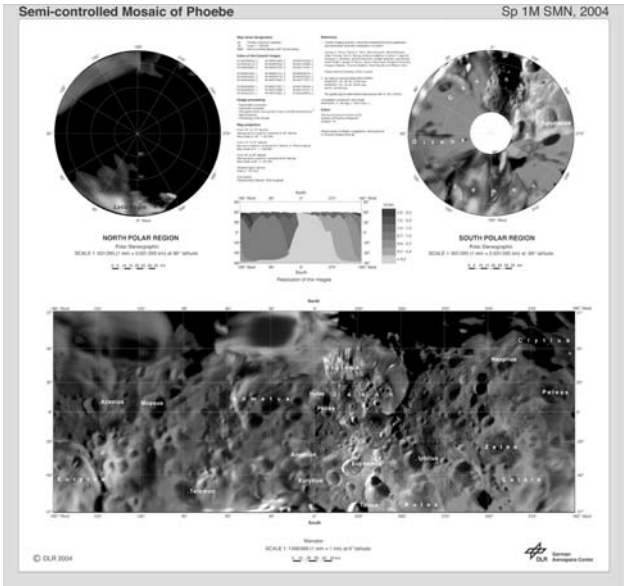

Figure 1: Phoebe map at 1:1,000,000 scale.