

# **THE SECOND STAGE OF THE MULTILINGUAL ICA PLANETARY MAP PROJECT: GIANT PLANET SATELLITES**

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## **Abstract**

The preliminary version of the Io Map 1:14 000 000 prepared for publication within the framework of the Russian-German ICA Project under guidance of the Commission on Planetary Cartography is presented.

## **1. Historical Background**

The idea to compile a new series of multilingual maps, namely those for giant planets and their moons, was discussed during the ICA Congress in Moscow in 2007. It has to be considered a continuation of the first series for multilingual maps of the Earth Group Planets and their moons. The first one of this map series was the Mars Map the preliminary version of which was exhibited in Stockholm on the occasion of the ICC in 1995. Based on the discussions amongst the community some corrections and improvements were made. The final Mars Map was represented at the ICA Congress in Ottawa in August 1999. Its scale was 1:25 000 000. Subsequently maps of Venus, the Earth's Moon, Mercury and the Mars satellites Phobos and Deimos were prepared following the same procedure. Besides the shaded relief representation each map of the second series has to include information about various parameters of these celestial bodies (astrophysical, geodetic etc.), a list of Latin terms for relief feature designation and a list of space missions to the respective planet or her moon. This information in five languages, namely German, Russian, English, French and Spanish, is placed on the back side of the map. This series can be considered a next phase of the creation of the multilingual celestial body maps. The Atlas of Solar System published in Moscow in 2005 was chosen as a basis for this map series. The format of the map sheet is similar to that one of the first series. This results in a scale of 1:14 000 000 for the Io Map.

## **2. Introduction**

It has to be noted that within the last years the interest in the celestial bodies far distant from the Earth has been increasing thanks to the more recent successful space flights like the Galileo and Cassini Projects. They yielded a lot of information about the

Galilean Moons of Jupiter, the largest Saturn Moon Titan and many smaller moons of the giant planets. On the other hand, the average knowledge of the public about the physical properties, shapes and relief of these celestial bodies is still rather meagre. The Moscow discussion at the ICC 2007 made it clear that the international interest in such a map series can be considered sufficient.

It has been decided to proceed the same way as with first map series, i.e. to present a preliminary version of the Io Map in Lambert Azimuthal Equivalent Projection at a scale of 1: 14 000 000 at the ICC 2009 in Santiago de Chile. This is again linked to the hope to produce a map of higher quality after some discussion of both the map contents and the collateral information.

The preprint has a format of 55 cm x 84 cm, the two hemispheres having a diameter of 47 cm x 78 cm. In addition to the map proper, imprint information in five languages was printed under the two Io halves.

### **3. Production Basis**

The current project is continuing the close scientific cooperation between the Moscow State University for Geodesy and Cartography (MIIGAiK) and the Institute for Cartography of the Dresden University of Technology (TUD). Since one main goal of the envisaged maps of this series was the high-accuracy depiction of the overall relief, an adequate representation had to be envisaged. A "classical" relief representation, which was already used for the Earth Group Planet maps, has been chosen: a pencil-made manual hill-shading prepared at MIIGAIK. It simulates a West illumination with an elevation angle equal/smaller  $40^{\circ}$ . So far, this pencil drawing on film seems to be the most impressive depiction of geomorphologic features of the entire moon: highlands and lowlands, mountains etc. are clearly perceivable. Thus, one can obtain a good impression of relief details of Io and, hence, simultaneously get an idea of its physiognomy as a whole. The overall quality, richness in detail and original size of the shading suggested the final map scale of 1: 14 000 000.

It has to be mentioned that the Io relief is very unusual and in many aspects different from the other celestial bodies of the Solar System. Io craters have several special characteristics and they are generally not like craters known from other planets and their moons. There are also many pateras. The different colours of larger as well as smaller areas are very difficult to represent because of active processes which change the relief situation. The same applies to the fluctus and their origins. The eruptive centres also represent interesting features

### **4. Map Production.**

Based on the decision on the final map scale, which resulted in a diameter of 39 cm of the two hemispheres, a first general map layout has been made. It became clear soon

that it would not be possible to print all the collateral information on the front side but to put it into text blocks in the back.

For the production process digital reprographic methods were applied, aiming at an equivalent of a repro screen of 54 points/cm for the relief shading original. A few attempts were made in order to optimise the reproduction of the relief representation, in particular to balance between the bright tones of the highlands and the darker tones of the lowlands.

The coordinate grid of the map whose geometry is based on the Transversal Equivalent Azimuth Projection of Lambert shows every twentieth parallel and meridian.

The lettering is kept in black and displays different fonts: for pateras 7 point Arial, capital letters; for mountain ranges 7 point Arial, italic, capital letters; for plains 7 point Arial, wide spacing, capital letters. Thus it gives explanations on all known and named geographic features. The type of lettering allows to deduce the geomorphologic categories.

Below the title "Io", between the two hemispheres, one finds the astronomical/astrological symbol for this planet.

For the printing several colors have been used. All letterings have been printed in black. The background outside the actual map-field is kept in "night-blue", representing the darkness of the outer space and using a special printing ink.

The paper format of the map is 55 cm x 84 cm, the format of the printed area being 47 cm x 78 cm which corresponds to the hemisphere diameter. The printed area in the back amounts to 43 cm x 81.5 cm. This is the size of a frame which contains explanatory texts about the map and the planet.

The front side comprehends imprint information about map designer, printer, editor, cartographers and consultants.

The back displays geophysical information about Io like density, radius, volume, albedo, orbit inclination, rotation period, and many more (Figure 1).

**English****Mass:**  $8.94 \times 10^{22}$  g**Density:**  $3.55 \text{ g cm}^{-3}$ **Reference Datum:** sphere**Equatorial Radius:** 1815 km**Surface:**  $4.137 \times 10^7 \text{ km}^2$ **Volume:**  $2.503 \times 10^{10} \text{ km}^3$ **Gravitational Acceleration:****at the Equator:**  $1.79 \text{ m s}^{-2}$ **Axial Inclination:**  $0.00^\circ$ **Orbit Inclination:**  $0.04^\circ$ .**Average orbital speed:**  $17.34 \text{ km s}^{-1}$ **Orbital Period:** 1.77 days.**Rotation Period:** 1.77 days**Average Surface Temperature:**  $-143^\circ\text{C}$ .**Albedo:** 0.061**Maximum Brightness:** 5.02 mag

Figure 1. Geophysical background information about Io.

**Io Sondes:****(having imaged Io)****1973 Pioneer 10 (USA)****1974 Pioneer 11 (USA)****1979 Voyager 1 (USA)****1979 Voyager 2 (USA)****1995-2003 Galileo (USA)**

Figure 2. Imaging Io sondes.

Besides a list of imaging Io sondes (Figure 2), a glossary of "Io-morphologic" terms like patera, eruptive centre etc. completes the backside information.

**Relief Forms of the Io:**

<b>Catena:</b>	crater chain of closely spaced depressions
<b>Fluctus:</b>	lava or mud flow
<b>Mensa:</b>	table mountain
<b>Montes:</b>	mountain range or mountain massif
<b>Regio:</b>	large region distinguished from the neighboring
<b>Patera:</b>	a crater of irregular form or complex crater with toothed edges
<b>Planum:</b>	plain, plateau
<b>Tholus:</b>	isolated small domelike mountain or hill
<b>Eruptive center:</b>	active volcanic center active volcanic center

Figure 3. Glossery of morphological terms occurring in the Io Map.

All this information is (from left to the right) given in English, German, French, Spanish and Russian (in cyrillic letters), each text block being printed in a light-grey, screened, elongate box of 14.6 cm x 39.8 cm.

The first edition of the multilingual Io Map amounts to 500 copies. Depending on the demand further print series will be produced.

The preliminary version of Io map is represented on Fig. 4

