

NEW PHOBOS ATLAS: GIS-ANALYSIS AND MAPPING

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ABSTRACT:

We have prepared an Atlas of Phobos, which based on new data from Mars Express mission and innovative techniques for recently derived Phobos control point network and shape model. The Atlas contains results of Phobos research, based on Mars Express images from the HRSC-camera including its SRC-channel. The Atlas includes 43 thematic maps describing various aspects of the surface of the small irregular body with various scale - from global maps (1: 250 000) to several local maps based on images with high resolution. The atlas is dedicated to the memory of Russian cartographers L.M. Bugaevsky (18.03.1921 – 04.08.2010) and K.B. Shingareva (09.01.1938 – 15.09.2013) who contributed greatly to the development of the first Russian map and globe of Phobos.

1. GIS-ANALYSIS

1.1 GIS “Phobos”

To organize the data in studies of the Martian satellite GIS “Phobos” has been developed (Karachevtseva et al., 2014). New Phobos control points network (Oberst et al., 2014) provides coordinate basis for GIS analysis and mapping as well as global digital elevation model (DEM) and orthomosaic. GIS integrated different type of data: gravity field; catalogue of craters and grooves; surface roughness; surface compositional distribution based on HRSC color-channel, ect.

1.2 Spatial analysis

As a result of the processing of collected information various derivatives products with spatial characteristics of the relief obtained. On base of digital geometric elevation model and dynamic elevation model geometric and dynamic slopes on baseline 400 m were calculated respectively. To represent surface roughness evaluation conducted on the basis of the area ratio method which is scale-independent and shows stable results regardless of the resolution of the original DEM.

1.3 The craters catalogue

The global catalogue of Phobos craters derived from global orthomosaic and separated orthoimages from Mars Express and Viking Orbiter (resolution 4 – 80 m/px). Visual interpretation of space images of Phobos crater catalogue allows to evaluate the distribution of craters on the surface and present the results on the basis of cartographic visualization techniques. Orthomosaic and crater catalogue are basis for various maps:

basic map (Fig. 1), map of crater density and map of crater distribution.

1.4 The grooves catalogue

The global catalogue of grooves contains 871 features, outlining grooves as central line. Attribute table of catalogue includes main characteristics of objects: length, width, orientation. Also objects were classified in three groups: line depressions, chains of separated funnels, chains of contiguous funnels. This catalogue was used for new geomorphology mapping of grooves (Fig. 2).

2. ATLAS AND WALL MAPS

Map is the best way to visualize geospatial data. On base of results of the Phobos GIS-analysis we have developed and designed the Phobos Atlas. Phobos Atlas contains over 40 maps with size 32×22 cm, which represent miscellaneous characteristics of surface and physical properties of one of Martian satellite, as well as description of study and results of Phobos research. While the Atlas is prepared in Russian, feature names will be presented in bilingual form (Russian and English), it is intended for international community, including different users like scientists, students and anyone interested in astronomy and planetary sciences.

2.1 Reference surface

Most part of map projections in Phobos atlas are based on the sphere with radius 11,1 km (Archinal et al., 2011). Exception is Phobos map in the modified Bugaevsky projection. This map is

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based on the three-axial ellipsoid with axis $a = 13.24$ km, $b = 11.49$ km, $c = 9.48$ km.

2.2 Global maps

For the all global topographic and thematic maps of Phobos the scale 1: 250 000 was selected. At this scale the main characteristics of the Phobos are mapped: relief and height above the sphere, gravity field properties (Uchaev et al., 2013), albedo (Patsyn et al., 2012), slopes and roughness at the 200 m baseline, geomorphological classification of craters and grooves (Basilevsky et al., 2014).

2.3 Base map in 7-sheets

Phobos base map compiled in the scale 1:100 000 and consists of 7 sheets according to Greeley and Batson (1990). For these map sheets contours in 200 m were generated from new Phobos DTM. In addition for outstanding landforms elevation marks were signed (fig. 1).

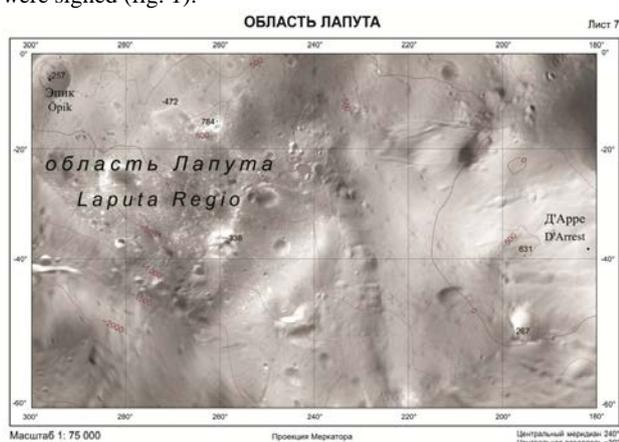


Figure 1. Sheet # 7 of base map – Laputa Regio

2.4 Large-scale maps

Two local topographic maps (1:60 000) are created for Drunlo and Stickney craters based on high resolution DTMs. The most detailed map (1:45 000) shows distribution of boulders on the part of Phobos surface, which represented on the MOC narrow-angle image SP2-55103 (Malin et al., 2000).

2.5 Wall maps

During work on Phobos atlas several wall maps were created. The first one is the map of Phobos in the modified Bugaevskiy projection for three-axial ellipsoid (1:150 000). It consists of 5 parts (central area and each of polar areas was divided for 2 parts) based on layout developed by Kira Shingareva. The second is the topographic map of Phobos (1:100 000), which duplicates map sheets from atlas on the single sheet. The third is the geomorphological map of grooves (Fig. 2), which represents results of “Mars Express” images analysis, cataloguing and classification of grooves. Moreover this map firstly displays the morphologic zoning of the Phobos surface, based on analysis of craters and grooves.

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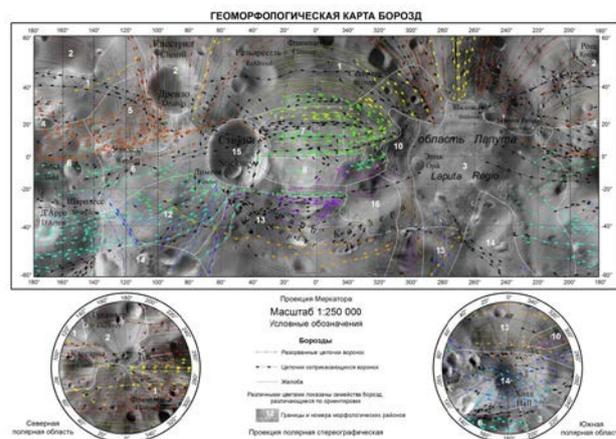


Figure 2. New geomorphologic map of grooves

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