

**MAPS AND GLOBES OF THE MOON COMPILED WITH PARTICIPATION
OF THE DEPARTMENT OF LUNAR AND PLANETARY INVESTIGATION
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Resume: A brief description of the mapping of the Moon carried out with the participation of the scientific workers of SAI and with the guidance of Y.N.Lipsky is taken.

In the Soviet Union the cartography of the Moon began with the launching of the Luna-3 space probe in 1959 which photographed for the first time ever the other side of the Moon. In 1960 the first map of the far side of the Moon was compiled on the basis of this data. It was prepared by the P.K.Sternberg State Astronomical Institute (SAI) and the Central Research Institute of Geodesy, Aerial Photography and Cartography. The Globe of the Moon was also issued (the scale 1:13 600 000). The special methods of the pictures treating joined the astrophysical and cartography methods were used under guidance Y.N.Lipsky. It allowed to show more details of far side relief.

The possibility of studying the global features of the structure of the lunar surface became real after completing the global survey of the Moon in 1965. Using materials of photographing the far side of the Moon from the Luna 3 and Zond 3 spacecraft and the best pictures of the near side the Sternberg State Astronomical Institute and USSR Topographical Service have compiled the Complete Map of the Moon (CMM) on a scale 1:5 000 000 on 9 sheets and the globe of the Moon at a scale of 1:10 000 000 which reflect 95% of the lunar surface and issued in 1967. For the CMM map the arbitrary cylindrical projection plotted under the condition that the distortion of the angles did not exceed $\pm 5^\circ$ in the region limited by parallels $\pm 50^\circ$ was worked out specially. The areas of formations on extreme parallels $\pm 60^\circ$ are increased on the map by 100%, while Mercators rectangular projection they would be increased 4-fold. Polar regions are represented in the equiangular azimuthal projection. The map also contains practically a full list of lunar names in Russian and Latin transcription. The CMM map and globe of the Moon were compiled under guidance Y.N.Lipskiy. Since 1966 the author of the paper was an editor of the maps. The second edition of CMM was issued in 1969 year. The photographic map of the visible side of the Moon at a scale 1:5 000 000 and the map for the equatorial zone at a scale 1:1 000 000 on 7 sheets were compiled on the basis of the data of groundbased telescopic surveys in 1967.

Thanks to the pictures taken from spacecraft Lunar Orbiters and space probes Zond 6,7,8 which have provided scientists with qualitatively new material drafting of the topography of the lunar surface has been improved considerably in CMM of the 3-rd edition in 1979. On the basis of the original of the relief shading of this map at a scale of 1:10 000 000 was prepared on a single sheet. This map is complemented by data on the areas of mare formations measured by J.F.Rodionova, the main stages of lunar studies by spacecraft and space-ships and by reference data as well as the map of the distribution of lunar rocks compiled by V.V.Shevchenko.

The fixing of pictures taken by Zond 3,6,7 spacecraft Apollo 8,11,13 was carried out by means of the unified multiplex designed at the SAI by V.I.Chikmachev. This multiplex makes it possible to restore optically the bundles of projecting rays, which existed at the moment of photography. Using the unified multiplex it is also possible to obtain photographic images corrected for curvature and inclination. The coordinate fixing on the map CMM-1979 is improved as compared with previous editions, especially in the central part of the far side of the Moon and in nearpolar areas. In the course of the relief shading wide use was made of photographs of individual regions projected onto the spherical screen and photographed from points chosen by the artist-cartographer V.V.Sokolov. Thus the "blank spot" in the southern polar area was decreased. On the CMM-1979 map 99.5% of the entire surface is reflected.

The appearance of the lunar surface on the photographs varies to a great degree with the change of lighting conditions. To correctly convey all specific features of this or that region it is necessary to have photographs obtained both in case of the low incidence of sunrays and in case of their high incidence. While for the visible side of the Moon there are detailed atlases of photographs taken in different lighting conditions, for the far side there are not such atlases.

On the maps of the Moon the difference of two basic types of the surface is well reflected: the highland type which occupies 83% of the surface characterised by the high albedo, considerable roughness and a large number of craters and the mare type -17%, which is characterised by the low albedo, the low, relatively smooth relief and a smaller number of large craters (fig.1, 2). Along with this widespread types of formations of the lunar surface are shown: craters with morphological features inherent in them, mountains, crests in maria, hills, domes, faults, valleys, rilles, chains of small craters. Over 20 000 formations are shown on the map.

The brightness features of the lunar surface are indicated on the map by variations of the tone of colour relief shading. With this aim in view the makeup of the boundaries of the areas of various albedo was preliminary constructed. Data on the brightness features of the surfaces enhances the information value of map. It has been established that the brightness of lunar material is determined by the chemical composition of rocks. The value of the albedo of the lunar surface can be used as a preliminary indication of the type of rocks having the predominant spread in a specific region. Craters with ray systems, which represent long and bright stripes radiated from craters, are also shown on the map, although these formations can be seen only in case of vertically falling sunrays.

Maps of the Moon are widely used for solving important scientific tasks. They have been used for obtaining such quantitative indices as areas of maria, large basins and craters, for zoning on the basis of one or several signs, for revealing spatial regularities as well as analysis of the distribution of typical topographic forms on the surface.

All the specific features of the Moon's relief described above are also reflected in detail on globes at a scale of 1:10 000 000 issued in the USSR in 1967, 1969, 1974, 1979, 1984, 1989 years. Every new edition was changed in accordance with IAU data of adopted names. The originals of the globe of the Moon were prepared in the form of 12 segments embracing zones of 30° longitude and $\pm 80^\circ$ in latitude as well as two near polar regions of the direct azimuthal equidistance projection. The original technique of transformation by means of the spherical screen was used in process of preparing the segments. New opportunities are opened with the use of thermal plastic materials, which makes it possible to pass over to the new technique of creating globes - the formation of entire hemispheres. Such globe was prepared in 1990 by specialists of NRKP amalgamation, SAI and the Central Research Institute of Geodesy, Aerial Photography and Cartography.



Fig.1 A frame of a segment of the lunar globe (hand made half-tone shading) for the region of far side which was photographed at first the Luna 3 spacecraft. On the top is Mare Moscovice; on the bottom is Tsiolkovsky.



Fig.2 A frame of segment of the lunar globe for the region to the south of Mare Imbrium.