

ASTEROID-ORBITAL ELEMENT OF THE LUNAR PROGRAM. V. Yakovlev¹ and N. Kovalenko², Laboratory of Water Quality «PLAYA», Ltd, Kharkov, Ukraine, yakovlev030157@gmail.com,² Kharkov National University, Kharkov, Ukraine, gorgguts@gmail.com.

Abstract: After half a century of man's first landing on the Moon, interest in space exploration and the development of space resources has increased. The main issue is resources, for the development of which the space countries are already creating special programs. It is easy to understand that space resources are needed, first of all, for the exploration of space itself. The universal home for man in Space will not be the surfaces of planets and their satellites, but biospheres with artificial gravity. And people will build these objects, taking into account their size, not on the Earth and the surface of the Moon, but in the orbits of the Moon and the Sun. We can say that the orbit of the Moon is the most convenient experimental and training ground for this purpose. The earliest achievement of this technical task, which is important for the survival of mankind - the creation of universal habitable biospheres, must be included in the lunar program of the orbital-asteroid element, regardless of the tasks of mastering the Moon itself.

To develop the necessary technologies, small asteroids can be delivered to the moon's orbit, and astronauts will take part in this, in addition to robots. Extraction, processing of raw materials, production of structures, delivery of materials and structures to the lunar surface, as well as assembly of various objects in orbit will be tested.

The second stage will inevitably be the development of the resources of larger asteroids in their orbits. This will be carried out mainly by robotic complexes, but the purpose of the work will be to prepare bridgeheads for inhabited colonies. Any asteroid from several hundred meters in size with sufficiently developed technologies and the availability of solar energy is a sufficient resource base for the long existence of a human colony. One of the suitable objects of such space expansion is the asteroid (99942) Apophis, which has a diameter of 325 m and a mass of $2.7 \cdot 10^{10}$ kg. The approach of this asteroid to the Earth in 2029 and 2036 to the Earth [1] will maximally simplify the task of delivering the necessary research and technological equipment to it. The asteroid belongs to the spectral class Cq, and among other useful elements in its composition, one can assume the presence of spodumene - a source of lithium (3.73% [2]), which is important in the long term for the manufacture of lithium-ion batteries.

It can be expected that the giant asteroid of the main asteroid belt (16) Psyche, with a diameter of 253

km and a mass of $2.41 \cdot 10^{19}$ kg [3], will become the main bone of contention between space countries in the foreseeable future. The giant asteroid belongs to the class M and contains, in addition to iron, platinumoids and gold in an amount that is many times greater than the earth's stocks. The entire world economy will be determined by the development of this pantry, and therefore the struggle for ownership of this object is inevitable. In July 2020, NASA announced the completion of the Psyche space station design phase [4]. The start of the first mission to this asteroid is accelerated, and is scheduled for August 2022, and in 4 years the device will reach its goal. The equipment of the apparatus is aimed at revealing the material composition of the asteroid.

The development of the process of space exploration will be determined by the resource base available on space objects. Therefore, the study of the material composition and the preparation of technologies for converting this material into vital resources is a primal task even now, when space seems to many to be only an object of scientific study. And all waste is secondary raw materials in space, there is no alternative, in contrast to the experience of developing earth resources.

Thus, the survival of mankind in conditions of limited resources depends on how well we know the material composition of objects in the solar system. The strategic goal of humanity - the development of the living space of the solar system - requires the inclusion of the orbital-asteroid element, the design of robotic complexes for the extraction and processing of matter in the open space, the development of projects for habitable biospheres and waste-free technologies for the use of resources in the upcoming lunar program.

References: [1] Башаков А. А., Питьев Н. П., Соколов Л. Л. Особенности движения астероида 99942 Апофис // *Астрономический вестник*. 2008.— Т.42, вып. 1. — С. 20—29. [2] Barthelmy, D. Spodumene Mineral Data. Retrieved 6 July 2020, from <http://webmineral.com/data/Spodumene.shtml#.Xxnuy nEzaUm>. [3] Sheppard, Michael K.; Richardson, James; Taylor, Patrick A.; et al. (2017). "Radar observations and shape model of asteroid 16 Psyche". *Icarus*. 281: 388–403. [4] "Building NASA's Psyche: Design Done, Now Full Speed Ahead on Hardware". NASA, 2020, <https://www.nasa.gov/feature/jpl/building-nasas-psyche-design-done-now-full-speed-ahead-on-hardware>. Accessed 8 July 2020.