SCIENTIFIC PROBLEMS OF CHOOSING THE SITE FOR A LUNAR OUTPOST. V.V.Shevchenko, Sternberg State Astronomical Institute, Moscow University, Moscow 119899, USSR

Analysis of the data already available, as well as remote studies of the Moon from the Earth make it possible to describe at the preliminary level the possible scientific tasks of a future outpost and the situation as regards local resources. The main advantage of the Moon as an object of research is the integrity of natural objects during a long geological period. That's why the fundamental objective of lunar studies is studying the early stages of the evolution of the solar system bodies. The western-eastern asymmetry of the lunar sphere is one of the most ancient events of the solar system evolution recorded in the nature of the Moon. The difference in the cratering of highland regions of the western and eastern hemispheres has become the most obvious sign of this specific feature in the Moon's structure. The crater distribution density characterizes the intensity of the precipitation of impact bodies in the period from the final stage of the Moon's accretion from the near-Earth swarm to the beginning of the era of mare volcanism. If we exclude the areas of the maria and young ring structures similar to Mare Orientale it will turn out that in the western hemisphere the crater density is systematically higher [1]. Hence, in the pre-mare era the asymmetry of the western and eastern hemispheres in the density of large craters was the determining external sign of the structure of the lunar surface. Most of ring structures and Oceanus Procellarum, which apparently is the most ancient of them [2], are also situated in the western hemisphere. Taking into account the large size of craters it can be stated that this, first of all, points to a much more ancient age of the highland areas of the western hemisphere.

Western-eastern symmetry is also traced as regards other parameters which primarily reflect the chemical composition of surface rocks. Highland rocks of the eastern hemisphere predominantly contain 6.5 to 9.5 weight per cent of iron. The surface layer of the highlands of the western hemisphere contains less than 6.5% of iron [3]. Since the shaping of the rocks of these areas took place more than 4 billion years ago the asymmetry of the lunar sphere described here reflects processes which occurred during the first 500 million years of the existence of the solar system. Thus, the tasks of fundamental lunar research call for the location of a lunar scientific outpost in the maximally possible proximity to the ancient highland areas of the western (while observing from the Earth) hemisphere of the Moon.

Turning to the problem of local natural resources, it is necessary, first of all, to consider areas of mare basalts with the enhanced titanium content in which ilmenites - the most productive rocks for the extraction of oxygen - are found in the greatest quantity.A modern forecast of the areas of the distribution of ilmenitic basalts is possible with the use of methods of planetary astrophysics and remote sensing. The boundaries of appropriate areas can be identified from combined images representing albedo and the spectrozonal characteristics of the surface [4]. The quntitative estimate of the per cent content of ilmenites in the surface layer is carried out on the basis of the empirical dependence of the slope of the spectrum in the interval 0.400 to 0.565 micron on the per cent content of titanium oxide in the rocks of the region under study [5]. Judging from these data the vastest sections of the distribution of ilmenitic basalts with a rather high content of this mineral are recorded in the western part of Oceanus Procellarum, inclu -

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ding regions which directly border on highland areas.

Principally important results in the considered direction have been given by the use of the technique of the remote evaluation of the density of the surface layer and the share of the fine-grained fraction in it [6]. Numerous studies by different authors have shown that more than 80% of hydrogen in lunar soil samples brought to Earth have been found in the fine fraction with the size of particles up to 45 microns [7, 8]. Using the results of laboratory measurements, the relationship between normal albedo, the maximum degree of polarization and the average optically effective size of particles was obtained. The possibility of the quantitative appraisal of the effective size of lunar soil particles on the basis of the above relationship was checked from the results of measuring the optical parameters of lunar samples with different size of particles [9].

As a result of studying the regions of the western part of Oceanus Procellarum by the above technique it has turned out that areas with the low value of the effective size of particles (<45 microns) coincide in some cases with the earlier indicated sections of the supposed distribution of ilmenitic basalts which enables one to hope that combined reserves of the most important lunar resources exist in the given localities. It would be natural to characterize these regions as the most optimum from the point of view of two main criteria - the carrying out of fundamental lunar studies and the availability of natural resources. Besides, additional studies have revealed some other specific features of the near-equator region of the western vicinity of Oceanus Procellarum as the key area for the Moon's nature [10] which enables one to characterize it in the following way.

Regions in the western part of Oceanus Procellarum identified as section of the distribution of ilmenitic basalts coincide with the places of the regional lava flows which begin in small craters and also with the system of sinuous rilles showing the direction of the motion of these flows. Apparently lava flows and their sources have become the paths of the delivery of ilmenitic basalts to the surface. The above features indicate the traces of late lunar volcanism and deserve a particularly careful study. In the chosen region - already according to preliminary data - one can expect the availability of natural resources in the form of ilmenite basalts suitable for obtaining oxygen, the region of the high concentration of the fine fraction which presupposes the enhanced content of hydrogen and helium-3,as well as the presence of volatiles as possible products of the eruption of the Moon's interior. The site chosen for a lunar outpost in Lacus Veris [11] has - according to our preliminary data - advantages regarding natural resources and the proximity to regions of the western ancient highland, but is separated from other objects enumerated above.

REFERENCES: [1]Rodionova Zh.F.& Shevchenko V.V.et al(1988),LPSC XIX, 992-993. [2]Whitaker E.(1981),Proc.LPSC-12A,105-111. [3]Metzger A.E.et al(1974), Proc. LSC-5,1067-1078. [4]Shevchenko V.V.(1986), Vestnik Akademii Nauk SSSR, No.10, 85-98. [5]Shevchenko V.V.& Busarev V.V.(1988),LPI Contrib.No.652,Houston,219. [6]Shevchenko V.V.et al(1990),Abstr.Papers Subm.to 12th Sov.-Amer.Microsymp., Moscow,72-73. [7]Crabb T.M.& Jacobs M.K.(1988),LPI Contrib.No.652,Houston,62. [8]Shevchenko V.V.& Chikmachev V.I.(1989),A Lunar Base-the Project of 21st Century,Moscow,VINITI Publ.,62-63. [9]Kvaratskheliya O.I. (1988), Bull.Abast. Astrophys.Obs.,No.64,Tbilisi. [10]Shevchenko V.V.(1990), Abstr.Papers Subm.to 12th Sov.-Amer.Microsymp.,Moscow,70-72. [11]Lunar Outpost(1989),NASA,JSC,Houston, 23.