SPECTROPHOTOMETRIC DATA ON THE VICINITY OF MARE ORIENTALE

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In August 1990 spectrophotometric observations of the eastern outskirts of Mare Orientale were conducted with the favourable libration of the Moon with respect to longitude. Observations were carried out by means of a spectrophotometer which operated in the mode of counting photons in the spectral range of 0.34 to 0.76 mcm with resolution of about 48 Å /1/ installed on a 60-cm reflector in the Crimea. The used angular resolution of about 7'' corresponded to an ellispoidal platform with transversal dimensions of approximately 13 km by 60 km on the lunar surface during observations of outlying regions. Observations were conducted by the usual method of differential spectrophotometry. The centre of the crater Plato for which the absolute fixing to α Lyr was earlier performed /2/ was used as a standard region. The difference of air masses during observations did not exceed the value of 0.024. In total, seven reflection spectra (observations were made during two nights on August 7/8 and 8/9 at the Moon's phase angles of about $+17^{\circ}.0$ and $+29^{\circ}.0$, respectively) of four platforms: Lacus Autumni ($= -12^{\circ}.2$, $= -83^{\circ}.5$)- spectra 1 (August 7/8) and 2 (August 8/9) in Fig. 1; the dark spot south of Lacus Autumni ($\varphi \cong -18^{\circ}.5$, $\lambda \cong -80^{\circ}.3$) - spectra 3 (August 7/8) and 4 (August 8/9) in Fig. 1; the dark spot south of Lacus Veris ($\varphi \cong -21^{\circ}.1$, $\lambda \cong -84^{\circ}.8$) - spectra 1 (August 7/8) and 2 (August 8/9) in Fig. 2; Lacus Veris ($\varphi \cong -13^{\circ}.8$, $\lambda \cong -87^{\circ}.7$) - spectrum 3 (August 8/9) in Fig. 2.

Mare Orientale is one of the largest impact multi-ring formations whose basin was filled with lavas of noritic and basaltic composition some 3.85 billion years ago /4/. As shown by analysis of the distribution of albedo performed from the picture of the Zond 6 spacecraft /5/ the shaping of Mare Orientale took place mainly in the course of four stages. After the first stage of the formation of the "background" surface of the basin (including the ring structure) from anorthositic gabbro the greater part of its surface with some outskirts (including apparently regions of Lacus Veris and Lacus Autumnis) was flooded at first by lavas of noritic composition (2nd stage) and then by lavas of basaltic composition overlapping almost fully the norite layer (3rd stage). The latter is associated with outflows of lavas which are also of basaltic composition in limited regions in the centre of Mare Orientale from which the darkest formations originated. Results of McConnell and Gast /6/ show that lavas of noritic composition on the Moon originate from depths of 100-200 km while basaltic lava from depths of 200-450 km. Therefore, the following mean trend is apparently traced for Mare Orientale: During the motion from the periphery to the centre the average content of the dark colour component of material (primarily ilmenite and pyroxene) coming from ever larger depths increases in regolith. The mechanical mixing of surface layers during meteoric bombardment can make this dependence more evident.

Our spectral data apparently confirm such distribution of dark material in the area of Mare Orientale. So, during the consistent observation of the above-mentioned platforms the decrease of values of the colour index C (0.56 mcm/0.40 mcm) is traced: for Lacus Autumni C = 1.980 ± 0.033; for southern outskirts of Lacus Autumni C = 1.937± 0.040; for southern vicinity of Lacus Veris C = 1.889 ± 0.025; for Lacus Veris C = 1.727 ± 0.032. Besides, practically all reflection spectra obtained have spectral signs of the presence of material of basaltic composition. Earlier we wrote about these signs in our papers /2, 3/, i. e. absorption bands are noticeable. They are associated with electronic transfers in the crystal field in Fe^{2+} and Ti^{3+} ions as well as the transfer of the charge of $Fe^{2+} \rightarrow Ti^{4+}$ and $Ti^{3+} \rightarrow Ti^{4+}$ /7/. But, which perhaps is the most important, the power of absorption bands in the interval 0.62 to 0.70 mcm is unusually great (up to 10 %). In this interval absorption is caused by electron transfers in Ti^{3+} ion and by the charge transfer $Ti^{3+} \rightarrow Ti^{4+}$. The depth of this absorption band also somewhat increases with the transfer from Lacus Autumni to Lacus Veris (see Figs. 1 and 2). The presence of the absorption band of 0.66 mcm of such intensity can perhaps be explained by the conclusion drawn by Sung et al. /8/ about the reality of the transformation of Ti^{4+} into Ti^{3+} in lunar conditions under the effect of high-temeperature and impact processes whose influence on basaltic material in the area of Mare Orientale could be very significant. It led to the high content of titanium in the form Ti^{3+}.

The results obtained can be of particular interest in connection with the forthcoming programme of observations of Mare Orientale from the Galileo spacecraft.

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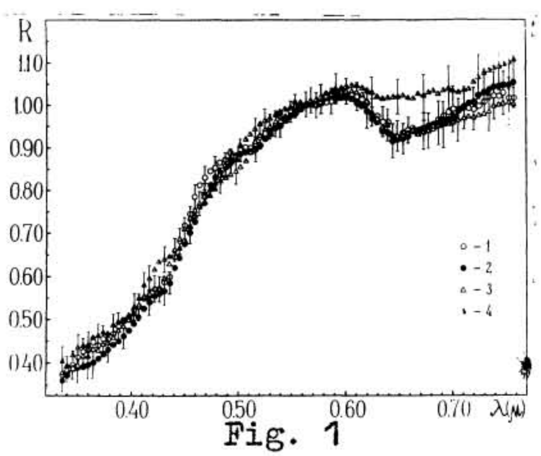

Fig. 1

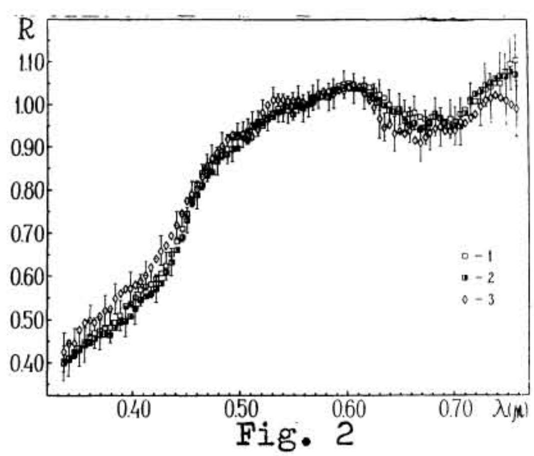

Fig. 2