REDUCED FORMS OF ELEMENTS INSIDE MINERAL GRAINS OF LUNAR REGOLITH. O.A.Bogatikov, N.A.Ashikhmina, D.I.Frikh-Khar, Inst.Ore Deposits Geology,Petrography,Mineralogy and Geochemistry,USSR Acad.of Sci.; E.N.Lubnin, Yu.Ya.Tomashpolsky, L.Ya.Karpov Inst.of Physical Chemistry; V.A.Stepanchikov, I.V.Kurchatov Inst.of Atomic Energy, Moscow, USSR.

The presence of reduced forms of iron,silicon,titanium and aluminium in surface layers of lunar regolith particles (1,2) has been attributed (3,4) mainly to the effect of "solar wind". An attempt was made to evaluate the degree of reduction of the elements within individual regolith particles using electron Auger spectroscopy (EAS).

3 individual grains of monoclinic pyroxene and 2 ilmenites with natural surface were studied using spectrometer "Varian" (energy resolution 0,6%). The particles 0,2-0,3 mm in size were taken from the drill core of the automatic station "Luna-24" in depth range of 1,76-1,92 m. For the analysis of internal zones of the minerals "splits-off" were prepared from the same sample. The estimate of ion bombardment-induced "instrumental" effect of reduction (5) and optimal regimes of dispersion were choosed using terrestrial analogues of lunar minerals lacking the reduced forms.

Various oxides of iron (Fe^{+3},Fe^{+2}), titanium (Ti^{+3},Ti^{+4}) and 4-valent silicon (Si^{+4}) are present at the natural surfaces of the grains studied. At the splitted surface of one pyroxene grain reduced forms of elements were not found. Reduced iron is detected in some spots at the freshly splitted surfaces of ilmenite particles (fig.1a). In the same spots reduced Ti^{+3} is registered (the amplitude of low-energy shoulder of Auger transition of titanium here is two times lower as compared to the same peak in terrestrial ilmenite (fig.2a). Completely reduced forms of iron are found in inner zones of lunar ilmenite grains produced by ionic dispersion (fig.1b). In deeper parts of the particles (0,7-0,8 m) the number of spots with reduced iron is more than in the subsurface layer. Since spectra of these sites lack the "oxide" peak, concentration of reduced iron, obviously, by far exceeds "instrumental" effect.Concentration of ions of Ti^{+3} also considerably exceeds "instrumental" effect (fig.2b).

In the course of dispersion of a lunar pyroxene grain in several areas containing small amounts of reduced iron and titanium (Ti^{2+},Ti^{3+}) an Auger - peak was been detected in the spectrum of silicon having energy of 92 eV corresponding to Si^{o}, its amplitude varing from layer to layer. Two other pyroxene grains where iron and titanium were not detected also lack Si^{o}. Layer - by - layer analysis of a splitted lunar pyroxene reveals Si^{o} with the concentration of 15-20% in one site of eight analysed at the depth of 0,4 μm and at depth of 0,7 μm also in one site.

Internal zones of a small clast of green volcanic lunar glass was studied using "Physical Electronics" Auger-spectrometer PHJ-545.

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Discrepancy is revealed between the observed oxygen and its amount necessary for complete oxidation of the components revealed by the analysis.

The presence and non-exponential distribution of the reduced forms in internal zones of lunar magmatic particles most likely are due to reductive properties of lunar magmatic matter. In such a case conditions for partial reduction of some (not all) elements have already existed in melt (green volcanic glass).

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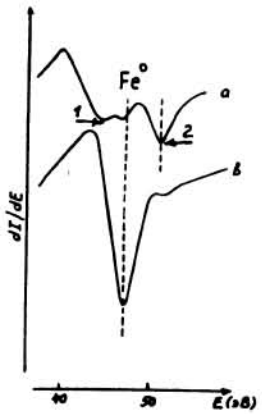

Fig.1. Spectra of characteristical Auger transitions of iron ($M_{2,3}VV$-Auger transition) in lunar ilmenite samples.
a. Spectrum detected at the splitted surface of ilmenite; arrows 1 and 2 show position of peaks for Fe^{3+} and Fe^{2+} respectively.
b. Spectrum of completely reduced iron detected at the splitted surface and inside the ilmenite.

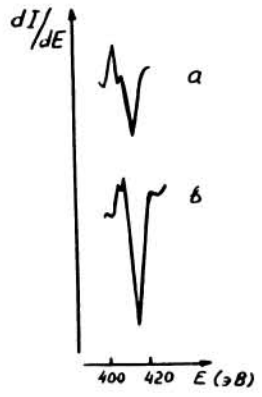

Fig.2. Spectra of Auger transition of titanium (E=416eV).
a. Spectrum at the splitted surface.
b. Spectrum in interior zones of ilmenite and pyroxene.

Fig.3. Auger spectrum of silicon in pyroxene.