THE POSITION OF VLT-LT AND VLT ROCKS IN EVOLUTION OF LUNAR BASALT MAGMATISM. Tarasov L.S. (1), Kudryashova A.F. (1), Bobrov V.A. (2), Vertman E.G. (3), Baryshev V.B. (4), Zolotarev K.V. (4). (1) Vernadsky Institute Geochemistry and Analytical Chemistry, USSR Academy of Sciences, Moscow, USSR; (2) Inst. of Geology and Geophysics and (4) Inst. Nuclear Physics, Siberian Branch of USSR Academy of Sciences, Novosibirck, USSR; (3) Tomsk Polytechnical Inst., Tomsk, USSR.

Introduction. The detailed investigations of fragments of mare type basalts from the highland region of the Moon [1-9] showed that they are more ancient than basalts of lunar seas. The isotopic age of a single Luna 20 basalt fragments has 3,91 b.y. ago [8], and basalts from Fra Mauro formation was formed 4,2 b.y. ago [9]. Thus a basalts magmatism on the Moon undoubtedly had more long and more ancient history [3, 9] than it was supposed. In this connection the important significance acquires knowledge on petrological and geochemical peculiarities of these very old rocks and them sources. Our investigations showed the important part among mare basalts belongs to transition type very low titanium - low titanium (VLT-LT) basalts. Thus from three basalt groups of mare type of Luna 20 [1-5] two groups are VLT-LT type and one is LT type. We have carried out the detailed geochemical investigation of these basalts by INAA and SRXFA methods [1-5]. The rock groups were selected on the base of data on distribution of main and rare elements. The latters are important for group identification [3] for example Hf vs. La, REE-spectrum etc. Simultaneously a similar rocks of VLT-LT type were identified by us among of Luna 16 fragments by SRXFA (Rb, Sr, Y, Zr) method [4, 5].

Results. As things turned out on the SRXFA data all VLT-LT basalts have low concentrations of incompatible elements (Fig. 1) that are identical to those in VLT basalts of Luna 24 [10]. Some of VLT-LT rocks have contents that are very similar to contents of these elements in Apollo 17 VLT basalts (Fig. 1). However VLT-LT basalts can not be full analogous of typical VLT basalts (Luna 24) as TiO_2 content have more wide range than in VLT rocks. In VLT-LT basalts the contents of TiO_2 rais higher than 1.6 wt.% (that is a provisisional boundary for VLT) up to 2.5-2.8 wt.% TiO_2. The lower contents of incompatible elements in VLT-LT and VLT basalts well different them from LT (low titanium) basalts of Apollo 12, titanium (T) Luna 16 basalts and high titanium (HT) rocks of Apollo 17 (Fig. 2). All VLT and VLT-LT rocks have more higher Al_2O_3 content (>10-11 wt.%). Therefore LT basalts of Apollo 15 that have Zr and Sr contents as in the VLT (Fig. 2) could not belong to VLT-LT type.

REE data are even more interesting. The Luna 20 mare basalts were divided into three groups (I, II, III) by the REE patterns (Fig. 3). Group I is LT type and is given for comparison. REE patterns of group II (VLT-LT) have low level of REE contents (C/CI=10-20), a small Eu minimum and little positive slope (little enriching in heavy REE). This rock group is geochemically low differentiated. It is homogenous. It seems like to VLT Luna 24 on the content rare elements but differs from Luna 24 by type of the REE patterns. Group III (VLT-LT) has clear positive slope of REE spectra, well Eu minimum and more low level of REE concentrations (C/CI=2-4 for La and 10 for Lu). These REE spectra are nearer to those of VLT of Apollo 17 [11] (1 and 2 spectra, Fig. 4) and are not like to the Luna 24 spectra (Fig. 4). Among REE spectra of Luna 20 there are not analogs to REE spectra of mare LT basalts of Apollo 14 [7] (Fig. 4).

Discussion and conclusions. 1. The samples of VLT-LT basalts were identified in Mare Fecunditatis and Apollonius highland region, and VLT basalts were found in Mare Crisium and in Mare Serenitatis. These basalts apparently are wide distributed in Eastern part of nearside of the Moon. On the Earth telescopic data the abundances of basalts, that have TiO_2 content less than 1.5 wt.% is large in the lunar northern sea regions [12, 13]. Thus both of these rock types are impotant components of the crust in various regions. 2. According to geochemical data (low contents of incompatible elements, individual position of points on the Zr-Sr diagram etc.) the origin of VLT and VLT-LT is different from the genesis of other mare basalts. 3. These criteria indicate on that in partial melting conditions the source of VLT and VLT-LT magmas should be rocks also poored incompatible elements. Moreover partial melting insignificantly changed of contents of these elements magmas. It means that part of melted rocks was large. 4. Such characteristics of the sources of VLT and VLT-LT indicate that these sources were undergone by differentiation in more ancient time and were restite formations at the time of VLT-LT and VLT partial melting. 5. Thus VLT and VLT-LT rocks are products of multistage processes of evolutions and belong to differentiating restite systems. Important peculiarity of them apparently is longtime activity of such sources. On the geologic data some VLT basalts from Mare Serenitatis have age more than 4.0 b.y., and other are yonger [11], one of the Luna 20 VLT-LT basalts have 3.91 b.y. age and Luna 24 VLT ba-

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salts have wide age range (from 3.54 to 3.25 b.y.) [14]. 6. On the total combination of these facts we suppose the existance two type of VLT-LT rocks (group II and group III of Luna 20 basalts) and two type of VLT rocks (types Apollo 17 and Luna 24). These illustrated by REE spectra in Fig. 3 and 4.

Fig. 1. VLT-LT and VLT basalts on the Zr vs Sr. Fig. 2. Position VLT-LT and VLT basalts vs T and HT basalts. Fig. 3. REE spectra for three groups of Luna 20 mare basalts. Fig. 4. REE spectra for VLT basalts of Apollo 17, VLT basalts of Luna 24 and LT basalts of Apollo 14.

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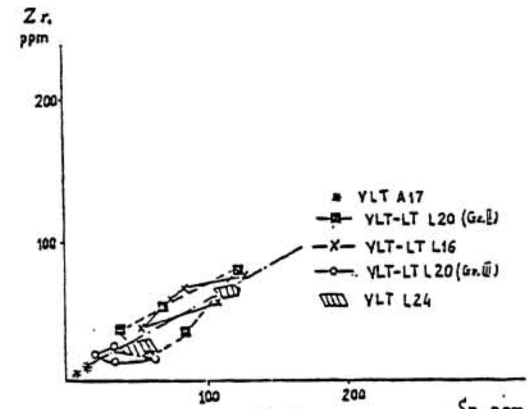

Fig. 1

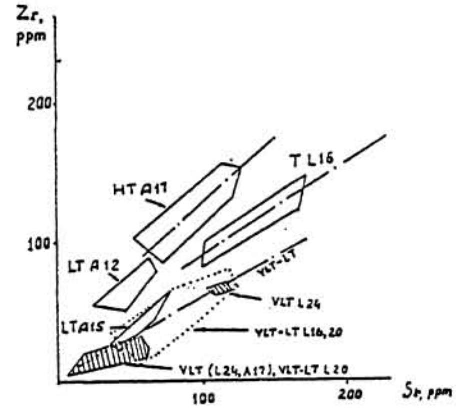

Fig. 2

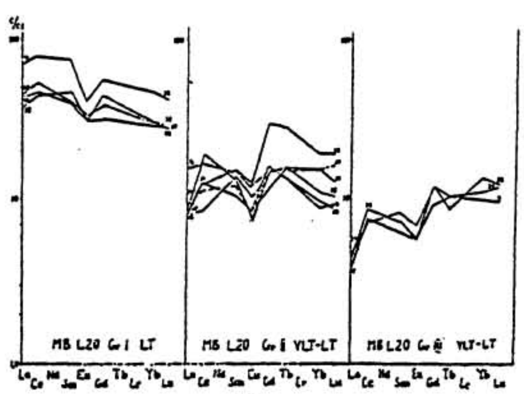

Fig.3

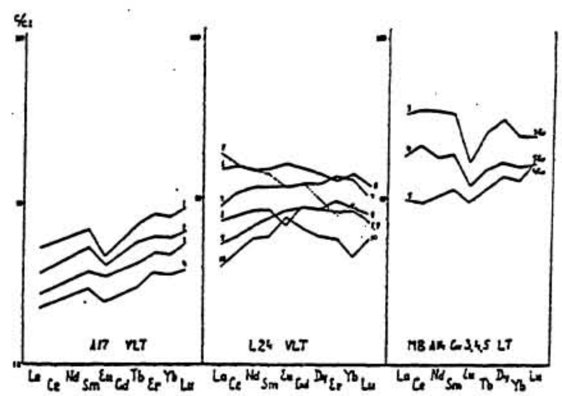

Fig.4