GEOCHEMICAL TENDENCIES OF DIFFERENT TYPES OF LUNAR ROCKS BY SRXFA DATA. Tarasov L.S. (1), Kudryashova A.F. (1), Ulyanov A.A. (1), Baryshev V.B. (2), Zolotarev K.V. (2), Mashtalka A. (3), Frana J. (3). (1) Vernadsky Institute Geochemistry and Analytical Chemistry, USSR Academy of Sciences, Moscow, USSR; (2) Inst. Nuclear Physics, Siberian Branch of USSR Academy of Sciences, Novosibirck, USSR; (3) Inst. Nuclear Physics, CS Academy of Sciences, Rez near Praha, CSFR.

Introduction. The aim of our work is systematical investigation of geochemical especial features of different petrochemical types of lunar rocks. In this connection we researched the distribution of incompatible elements (Rb, Sr, Y, Zr, Nb, and partly Ba, La, Ce) in small (0,4-3,0 mm) fragments of these rocks by X-ray fluorescent method with using synchrotron radiation (SRXFA) [1-7]. The methods and equipments were described in refs. [2-4, 6-11]. In all more than 300 rock fragments from all landing sites of soviet automatic stations and american missions on the Moon were investigated. The BCR-1 was used as external standard and W-1 was used as control sample. The errors of determination of elements were 5-10% and more rare up to 15% for different elements. The INAA data based on shortlived nuclides were used for petrochemical grouping by claster analysis. These data were obtained in INP (CSFR) earlier. Part petrochemical data were obtained in Tomsk and Novosibirsk [12]. In this report we consider the distribution of Zr and Sr, as more informative pair only.

A main rock types. We considered next rock types (Fig. 1, 2, 3): very low titanium (VLT) basalts (Luna 24, Apollo 17); transition type from very low titanium to low titanium (VLT-LT) basalts (Luna 16 ,Luna 20); low titanium (LT) basalts (Apollo 12 and 15); different types of titanium (T) basalts (Luna 16, Apollo 17); high titanium (HT) basalts (Apollo 11 and 17). Cumulative type of low aluminous-high titanium (LA-HT) (Apollo 17) and suite of very high aluminous (VHA) and anorthositic (ANT) rocks from mare and highland regions of the Moon were distinguished also.

Problems. The main petrologic questions of lunar rocks investigations connected with genetical relations as between various types of mare basalts as between mare basalts and high aluminous rocks. The latters are distributed both in the highland regions and mare basins. The question is: there VHA rocks product of highland crust matter or some part of them are product of evolution of mare basaltic magmas? In many works VHA rocks are connected with highland crust only.

Results. The obtained data we shall consider accordingly to three grouping of rocks: 1) VLT, VLT-LT, T (Luna 16, 20, 24) (Fig. 1); 2) LT, HT and related T and LA-HT (Apollo 12, 15, 17) (Fig. 2); 3) highland VHA-ANT and siutes HA and VHA from highland and mare regions (Fig. 3). In the Fig. 1 we see trend of VLT-(VLT-LT) rocks [2, 5, 12] and separate trend T basalt of Luna 16. For the second grouping a picture is different (Fig. 2). There is relative short HT trend of Apollo 17 basalts. It is subparallel to Luna 16 T-basalt trend. Its continuation corresponds to trend of T-basalts of Apollo 17 which is more steeper and parallel to HT Apollo 11 trend (in high Zr concentration region). The short trend of the cumulative LA-HT rocks of Apollo 17 is in low Zr and Sr concentration field (Fig. 2) [4]. Near to it there are sloping fields of LT Apollo 12 and 15 basalts. Each of the rock type has a regional features. For third grouping (Fig. 3) we have complex picture: there are many groups and fan of trends corresponding of these groups on the graph (Fig. 4). This fan we can divide into three types. First is in low Zr concentration region and consists of very local groups of figurative points. These are ANT and VHA rocks of Luna 20 and Apollo 16 and 17. Its are highland rocks. The other type is short trend with more steeper angles (30-40° ) in LT field. And third type are subparallel very steep (74-78° ) trends of various VHA rocks. These are short trends of Luna 20 (110-220 ppm Zr), Apollo 16 (220-300 ppm Zr) and Apollo 17 (170-430 ppm Zr) trends (Fig. 3,4). On the continuation of these trends (300-550 ppm Zr) there is a trend of Apollo 12 rocks. In more higher Zr concentration region there are several very steep (78--80°) trends of Apollo 14 & 15 (410-1100 ppm Zr), Apollo 14 (590-1000 ppm Zr) and Apollo 12 (450-850 ppm Zr).

Discussion and conclusions. The representative scheme of trends has several special features. One of them is a crossing of trend of mare basalts and of steep VHA trend for the same moon region. There are a crossing of the trends for other rock types. Such points are marked on the Fig. 4 as shaded circles with Roman figures. For examples poin II (crossing Apollo 17 trends of HT and VHA rocks) or point IV (crossing Luna 16 trends of T and HA-VHA rocks). These points of crossing can indicate on ancient common geochemical parameters (concentrations of elements) and consequently on common sources of both magmas. As a rule the rock suites corresponding to crossing trends has different isotopic age and hence age of crystallization. Therefor each rock suite was differentiated from common source in different time and characterized of different stages of evolution of source. In each pair the VHA rocks are more ancient (about 0,1-0,3 b.y.) than corresponding mare component.

The III point indicate differentiation of T basalts from HT basalts (Apollo 17). Geochemical differences T basalts of Apollo 17 from T basalts of Luna 16 are very clear (Fig. 1, 2, 4). This indicates on different sources of these rocks. The point I marks of regressive (cumulative) differentiation of melanocratic high titanium component (LA-HT) from high titanium magma on a deep of Mare Serenitatis. One can see the points of differentiation (I-IV) have T and HT magmas only. Low differentiated LT magmas of Apollo 12 and 15 have not point of crossing, as VHA trends corresponding of them are displaced in a very high Zr concentrations field. They are very differentiated magmas similar to VHA and KREEP magmas of Apollo 14. The highland (Luna 20 and Apollo 16) rocks have not such high differentiated trends. This suggests that VHA rocks of mare regions are genetically connected with intensive differentiation processes in the deep of these regions. These VHA rocks can be associatied with evolution of sources producing mare type magmas in future. The all systems are geochemically progressive (besides LA-HT): they enriched in incompatible elements during evolution. Naturally, complementary petrological systems (regressive) should be poored of these elements. Apparently the most part of them are not known at present and are hidden on the deep of lunar interior. The search of such rocks is very topical. The examples of heirs of regressive systems are evidently VLT and VLT-LT basalts. Partly its was formed in premare time. They are described in companion abstract [12].

Fig. 1. Zr vs. Sr diagram. The fields of mare basalts of VLT, VLT-LT and T types are indicate. Fig. 2. Zr vs. Sr diagram for LT, T and HT rocks. Fig. 3. Zr vs. Sr diagram for VHA and VHA-ANT rocks. Fig. 4. Summary diagram of trends.

References: 1. L.S.Tarasov et al. LPS XVII, (1986), p. 871; 2. L.S. Tarasov et al. Nucl. Instr. and Meth., (1987), A261, p. 263; 3. L.S.Tarasov et al. Preprint INP 88-82 (1988), Novosibirsk, (in Russian); 4. L.S.Tarasov et al. Nucl. Instr. and Meth, (1989) A282, p. 677; 5. L.S.Tarasov et al. Nucl. Instr. and Meth., (1989) A282, p. 669; 6. A.F.Kudryashova et al. Nucl. Instr. and Meth., (1989), A282, p. 673; 7. L.S.Tarasov et al. In "Synchrotron radiation in Geochemistry", Nauka, Novosibirsk, (1989), (in Russian); 8. V.B.Baryshev et al. Journ. Anal. Chem., (1986), v. 41, p. 389; 9. V.B.Baryshev et al. Preprint INP 88-26 (1986), Novosibirsk, (in Russian); 10. V.B.Baryshev et al. Nucl. Instr. and Meth., (1987), A261, p. 279; 11. V.B.Baryshev et al., Nucl. Instr. and Meth. (1989), A282, p. 570; 12. L.S.Tarasov et al., LPSC XXII, this volume.