GEOCHEMICAL IDENTIFICATION OF VLT-LT BASALTS FROM MARE FECUNDITATIS AND APOLLONIUS REGION

Tarasov L.S.(1), Kudryashova A.F.(1), Semenova A.S.(1), Baryshev V.B.(2), Zolotarev K.V.(2). (1)Vernadsky Institute USSR Academy of Sciences,Moscow,USSR; (2)Ist.Nuclear Physics,Siberian Branch of USSR Academy of Sciences, Novosibirsk, USSR.

INTRODUCTION. For the recent years intensive attention has been focused on mare type lunar basalts from highland regions. In has been shown that a part of them was more ancient then basalts from mare regions /1,2/.Thus a possibility to obtain information on more ancient hystory of lunar basaltic magmatism has become a reality. We determined VLT basalts among mare type basalts from Apollonius highlandregion (Luna 20). This work has been done on the base of rare element distribution by X-ray fluorescence analisis with sinchrotron radiation (SRXFA) /3,4/. One fragment of VLT type rock is of 3.91 b.y.ago /2/. Till now VLT basalts were found in Mare Crisium and as individual fragments - in Mare Serenitatis only.

In this connection we carried out a special investigation of these basalts on the base instrumental neutron-activation analysis (INAA)/5/. As a result several groups were found among these rocks:three groups low titanium mare basalts (VLT and LT,group I,II,III), high aluminous (HA) and very high aluminous (VHA) non-mare basalts (group IV and V) and group VI of highland rocks (ANT). From all of these basalts groups II and III were more interesting as VLT and LT rocks with low contents of rare elements. Thus they were similar geochemically to the VLT type basalts. It should be noted that a clear boundary between VLT and LT basalts on Ti content can not be marked. However there is a difference between basalts of group II and group III according to the distribution of rare and rare earth elements/5/.In this connection geochemical characteristics of the found basaltic groups should be clarified by SRXFA /4,6/ on the base of determination of Rb,Sr,Y,Zr,Nb in the same fragments which have been investigated. The main objects were the rocks of group II and III. A set of 15 fragments was separated from INAA series /5/of Luna 20 rocks: four samples from groups II and III and 1-3 samples from other groups.The number of groups is the same as in /5/.

During the petrographic research of Luna 16 basalts the presence of several fragments of intermediate VLT-LT type was determined /7/. Therefore in 1988 new series of specially separated Luna 16 samples including 29 fragments was investigated by SRXFA in addition to Luna 20 basalts.

RESULTS OF WORK.Previously distinguished groups (on the INAA base)/5/ in this work standed out by SRXFA data in the various bi-correlation plots of Rb,Sr,Y,Zr and Nb rather well.These regularities for Luna 20 and Luna 16 shall be demonstrated on the example of the Zr/Sr plot (Fig.1 and 2).In this plots the number of groups for point cluster or individual points are marked,by Roman numerals (Luna 20) or Arabian numerals (Luna 16). The types of rocks are marked also.

In all these plots the points of the rock analyses of groups II and III are in the field of Luna 24 VLT basalts /8/ near the origin of coordinates. The difference between group II and III is not so clear, although the fields of these groups do not overlap each other. The points of group IV (HA-VHA) are set a long the high aluminous basalt trend for Luna 20 /4/. New SRXFA trace element concentration data confirm our preliminary suggeston /5/ about the possible presence of VLT basalts in igneous rocks from highland Apollonius region (Luna 20). As well as for Luna 24 samples, all the basalts of Luna 20 ( group I except) are aluminous and high-aluminous varieties. The basalts of groups II and III from Luna 20 samp les have titanium content of 0.6 to 2.2 $TiO_2$ wt.%. Therefore we suppose that the basalts of groups II and III are an transition VLT-LT type petrochemically, which geochemical features are similar rather to VLT-basalts than to Apollo 12 and 15 LT-basalts. We did not obtain any trend for titanium basalts of Luna 20 like the one for basalts of Luna 16. The investigation of a new series of Luna 16 samples carried out in 1988 makes it possible to determine four groups on the base of Rb,Sr,Y,Zr and Nb contents (Fig.2). GroupI is highland rocks of ANT-type. Group 3 and 4 in Zr/Sr plot well disposed along trend of Luna 16 titanium and high aluminous basalts. This trend was determined earlier /3,4/. Therefore both groups 3 and 4 should belong to common Luna 16 titanium basalts enriched in rare elements in various extent.These new data show the presence of VLT-LT basalts (group 2) in Luna 16 rock series as in Luna 20 (group II and III). In Luna 16 series VLT-LT basalt have not be determined yet. This identification based on geochemical criteria: low concentration of rare elements and the arrangement of points of group 2 (Fig.2) in VLT basalt field. Thus these groups of VLT-LT basalt (group 2 in Luna 16 and group II and III in Luna 20) are very interest ing rocks as a new type among the igneous rocks of the Moon. The rocks of VHA series are not found among the new Luna 16 set of samples.

© Lunar and Planetary Institute • Provided by the NASA Astrophysics Data System

# GEOCHEMICAL IDENTIFICATION OF VLT-LT BASALTS

Tarasov L.S. et al.

DISCUSSION. The most important result of the investigation of the Luna 20 mare type basalts and the new series of Luna 16 rock fragments is that in both series VLT-LT rocks geochemically similar to Luna 24 basalts have determined. The common caracteristics for all these rocks are low rare element contents, high aluminous type rocks and low and very low titanium content. The latters for Luna 16 group 2 are not confirmed yet by chemical analyses but are well seen from recalculation of modal composition for analogous fragments from the same rock series /7/. This is right for Luna 16 VLT-LT jugding by the modal composition data also/7/. In /7/ essential mineralogical differences between Luna 16 VLT-LT rocks and main titanium basalts of Luna 16 are shown. Some differences between VLT-LT basalts of Luna 16 and Luna 20 are determined also /7/. Part (and may be the majority) of studied Luna 20 basalts are more ancient (to 300-600 m.y.) /2/, than common basalts from Mare Crisium /9/ and Mare Fecunditatis /2/. That is why it may be supposed that aluminous VLT and LT basalts began forming at the early premare stage of melting of lunar basalt magmas. It continued for a long time untill the VLT basalt of Mare Crisium eruptions. The age of the Luna 16 VLT-LT basalts is unknown. One can suppose that these basalts and the common basalts of Mare Fecunditatis are practically of the same age (3.6 b.y.) or more ancient. In the last case these basalts could have been thrown over from surrounding more ancient places by big impact (for example Webb or Langrenus) or escavated from lower basalt layers of Mare Fecunditatis /7/. Evidently for a long period of time - 3.9-3.3b.y. -melting of source material very depleted in rare elements was taken place.

REFERENCES. (1) Taylor L.A. et.al. (1983) EPSL, p.33; (2) Fugsan M.M. et.al. (1985) LPS XVI, p.256; (3) Tarasov L.S. et.al. (1986) LPS XVII, p.871; (4) Tarasov L.S. et.al. (1987) Nucl.Inst.Me-thod, p.263; (5) Tarasov L.S. (1988) LPS XIX, p.1179; (6) Tarasov L.S. et.al. (1984) Proc.6th Nat.Conf.Use.Synch.Rad., Novosibirsk, USSR (in Russian). (7) Semenova A.S. et.al. (1989) LPS XX, this volume; (8) Tarasov L.S. (1986) LPS XVII, p.873; (9) Fugsan M.M. et.al. (1984) LPS XV, p.278.

Fig.1. The groups (I-VI) of Luna 20 rocks in the Zr/Sr plot; Fig.2. The groups (1-4) of Luna 16 rocks in the Zr/Sr plot.

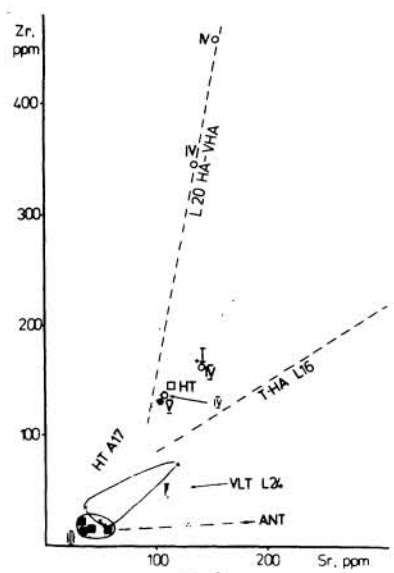


Fig.1

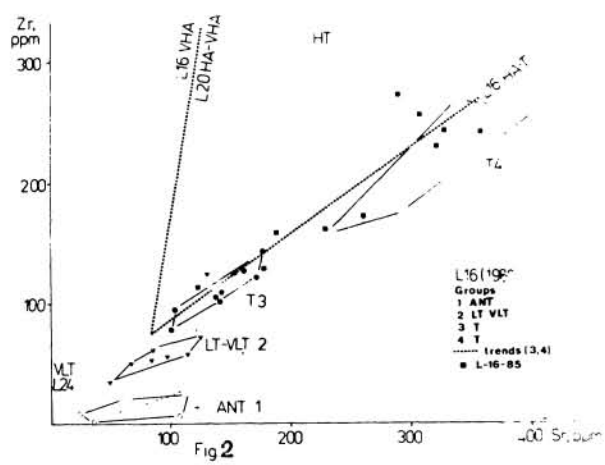


Fig.2

© Lunar and Planetary Institute • Provided by the NASA Astrophysics Data System