Luna 16

Drill Core

101 grams

DRAFT

6 cm.

21000 **A**

8 cm.

21020 B

29 cm.

21010 **G**

31 cm.

Figure 1: Copy of Russian photo of Luna 16 core after initial disection showing position of three samples provided to US workers (21000, 21010 and basalt chip B 21020). NASA S71-38646 and 38647). Location of B is approx. See also figure 9.

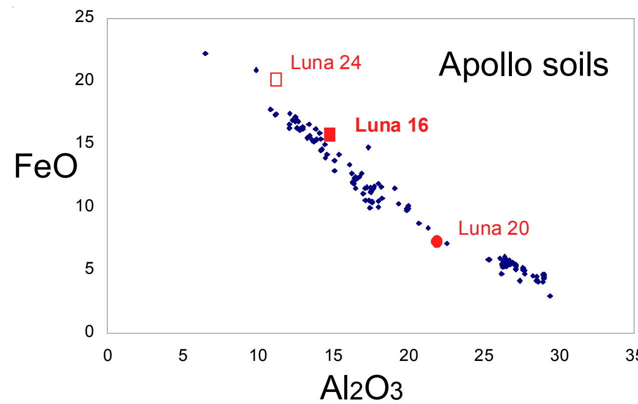


Figure 2: Comparison of composition of lunar soils compared with that of Luna 16.

Introduction

Luna 16 was, in fact, the third mission to collect samples of the Moon (*there were no known lunar meteorites at the time*). The automatic Luna 16 station collected a 36 cm deep core into the regolith and successfully returned it to Earth in a small capsule. A large book (*in Cyrillic*) is dedicated to the study of the Luna 16 samples by scientists from all over the world (ed. Vinogradov 1974). A booklet from India, and volume 13 of EPSL also contain additional early publications. *This humble summary is simply an attempt to pull together some of what's now known about this remarkable achievement.*

Vinogadov (1971) gives a complete description of the 35 cm long Luna 16 core, which was subdivided into 5 principle zones (A – E, figure 10). The grain size and overall characteristics of the Luna 16 sample are similar to mare soils returned by the Apollo missions. Basalt fragments make up the majority of the sample and they have been dated at 3.4 b.y. The basalts from this region appear to be more aluminous than most of the Apollo basalts.

The geologic setting for Luna 16 is outlined in McCauley and Scott (1972) and Florensky et al. (1974)(*in Cyrillic*). The landing was on a mare surface of an old basin (Fecunditatis). Rays formed by material ejected from craters Langrenus (250 km south),

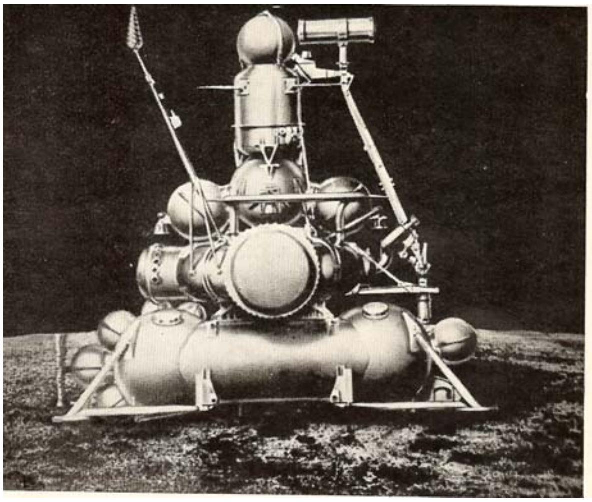


Figure 3: Photo Luna of spacecraft.

Taruntius, Theophilus, and even Tyco, brighten the mare surface in the vicinity of the Luna 16 site.

Petrography

Vinogradov (1971) found that the Luna core was coarser (on average) with depth (figure 1). Grain size distributions are given in Stakheyev et al. (1974)(*in Cyrillic*).

Reid et al. (1972), Bence et al. (1972) and Tarasov et al. (1974; *in Cyrillic)* published modes showing that about 20% of the fragments are fine-grained basalts (figure 7). Simon et al. (1981) gives the mode in a manner that can be compared with other samples (see table and figure 6).

The small (62 mg) basalt fragment B1 was described by Albee et al. (1972) and is featured separately (*see 21020*). Grieve et al. (1972) described 3 additional basalt fragments (total weight 1.88 mg). The bulk analyses of these basalt are similar Table 2) and they all have iron rich pyroxene (figures). Bence et al. (1972), Steele and Smith (1972), Hollister and Kulik (1972), Tarasov et al. (1974) and others all reported on the petrography of various small fine-grained basalt fragments from the Luna 16 core.

Reid and Jakes (1974), Kurat et al. (1976) and Cimbalnikova et al. (1977) recognized that a fair portion of the Luna 16 basalts are "aluminous" in character (table 2b).

Mineralogy

Numerous investigators reported on the composition of pyroxene grains in basalt fragments and soils (figures 5a,b,c,d).

Haggerty (1972), studied the opaques in the Luna 16 soil, finding that the spinels followed a slightly different trend from the Apollo samples.

Jakes et al. (1972), Keil et al. (1972), Jin and Taylor (1990) and Simon et al. (1981) determined the chemical composition of numerous glass particles in an attempt to identify "rock types" that may be present in the area around the landing site. Apparently about half the glass comes from the nearby highland (figure 9). Ivanov et al. (1974) and Glass (1974) also studied glass beads from Luna 16 (*published in Cyrillic*). Glass of volcanic origin is still to be identified.

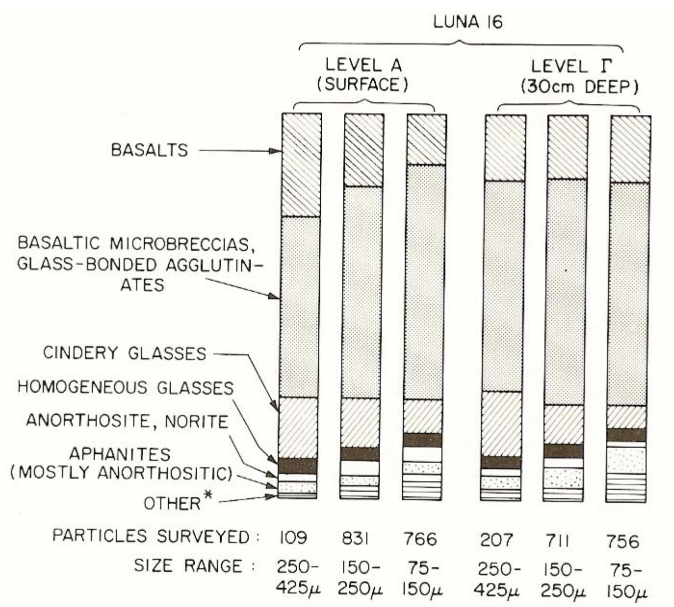


Figure 4: Histogram of rock types found in various size fractions of Luna 16 (from Reid et al. 197).

Mineralogical Mode for 21000

Simon et al. 1981	90-20	20-10 micron
Lithic fragments	26.5	9.4 %
Agglutinates and DMB	39.4	26.2
Pyroxene	18.9	15.8
Plagioclase	4.7	16.1
Olivine	3.3	5.7
Opaques	0.6	3.7
Silica		
Mare Glass	1.8	10.7
Highland Glass	3.7	12.1

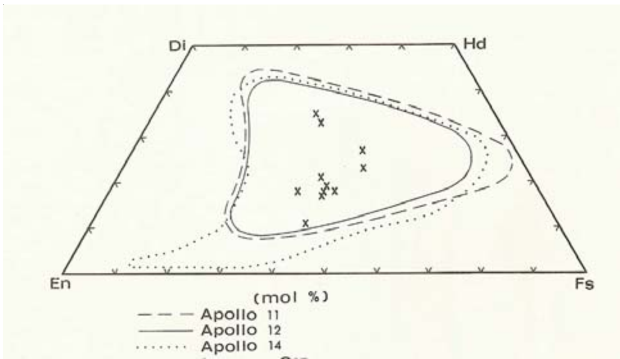


Figure 5a: Composition of Luna 16 pyroxene compared with Apollo missions (in Steele and Smith 1972).

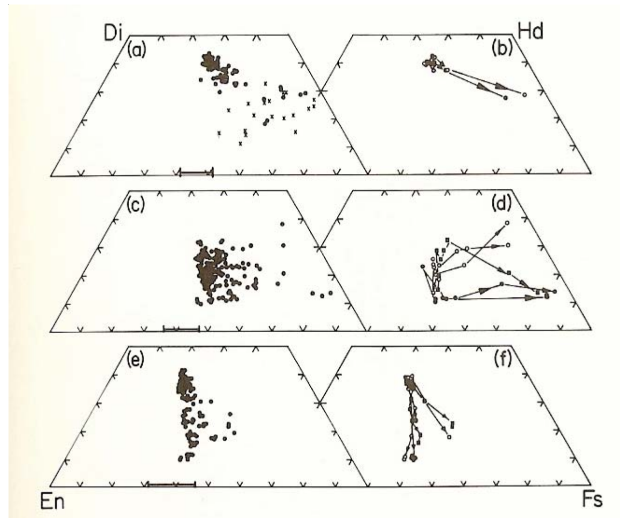


Figure 5b: Composition of pyroxene and olvine from three basalt fragments from Luna 16 (Grieve et al. 1972).

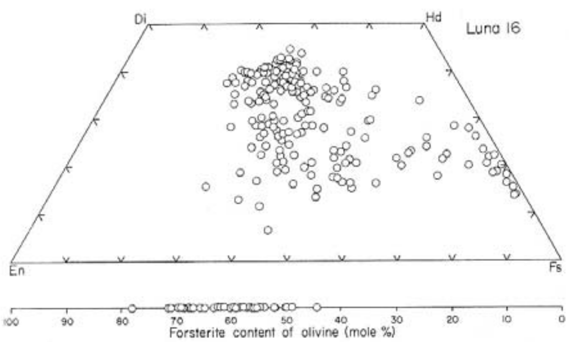


Figure 5c: Composition of pyroxene and olivine from aluminous basalt fragments from Luna 16 (Kurat et al. 1976).

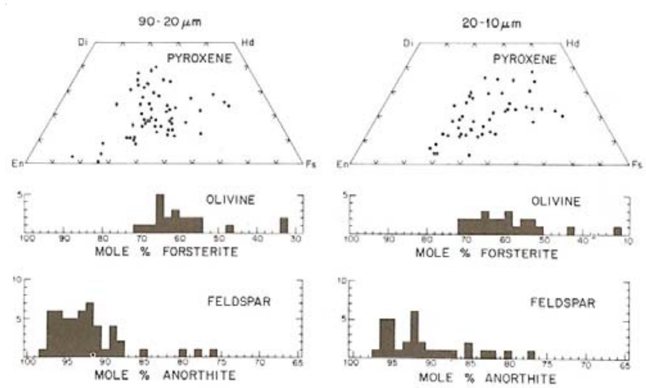


Figure 5d: Pyroxene, olivine and plagioclase by Simon et al. (1981).

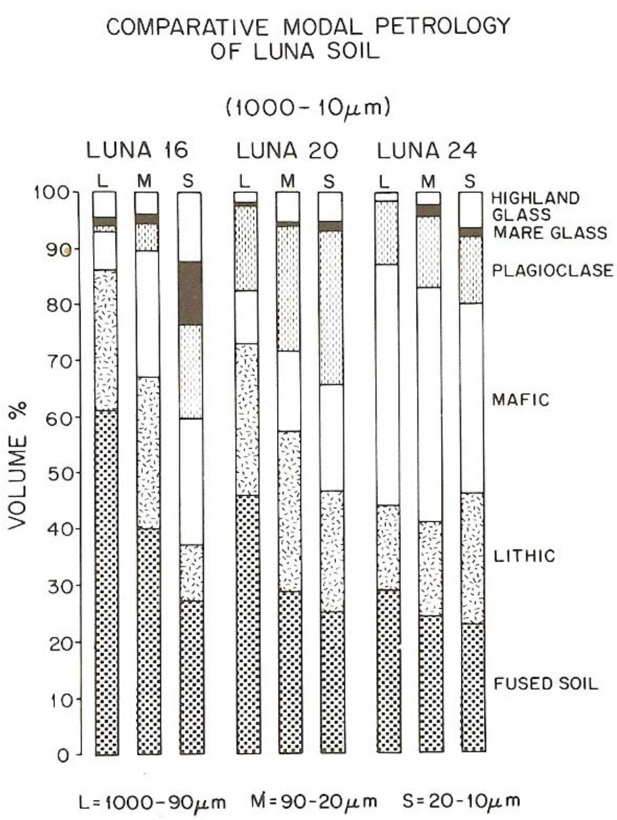


Figure 6: Mode a la Simon et al. 1981.

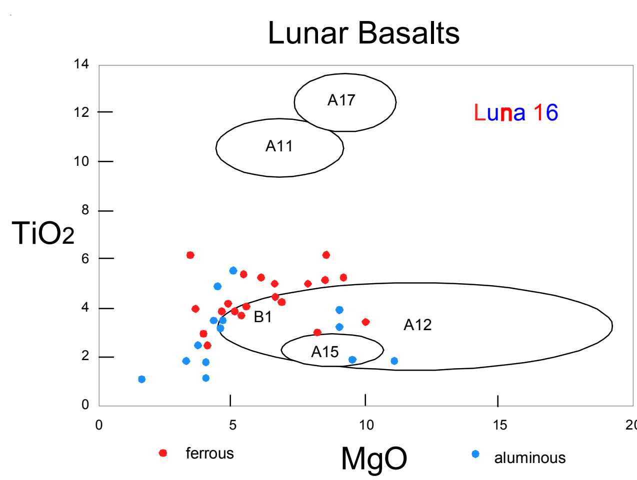


Figure 7: Chemical composition of Luna 16 basalt fragments (all small, so variable, see tables).

Chemistry

Vinogradov (1971), Laul et al. (1981) and others determined the bulk composition and the composition of various grain size separates (table 1). Various individual basalt fragments and other lithic fragments were also analyzed (table 2). The Ti and Mg contents of basalts is plotted in figure 7 and compared with basalts from other lunar missions. Various investigators noticed that Luna 16 basalts are more aluminous than most basalts returned by Apollo missions. The rare earth element pattern for the soil is exactly parallel to that of the basalts (figure 8).

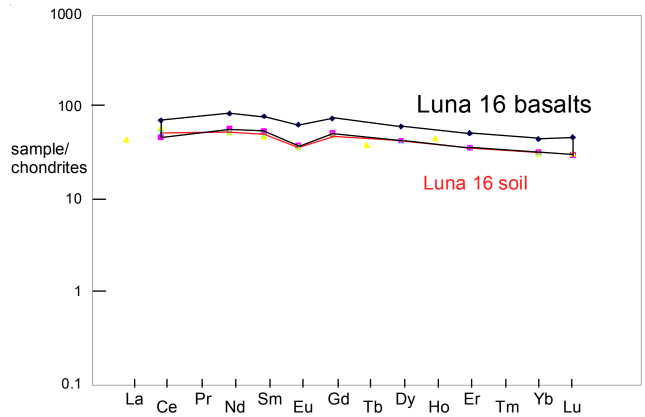


Figure 8: Normalized rare-earth-element diagram for Mare Fecunditatis.

Radiogenic age dating

Papanastassiou and Wasserburg (1972) and Huneke et al. (1972) determined concordant Rb-Sr and Ar-Ar ages (~3.4 b.y.) for one of the larger basalt fragments (21020) from Luna 16 (*see 21020*). Cadogen and Turner (1977) and Kirsten and Horn (1977) attempted to date Luna 16 particles. Vinogradov (1974) also reported age data.

Cosmogenic isotopes and exposure ages

Huneke et al. (1972) determined an exposure age of 475 m.y. by ^{38}Ar for basalt B. Russ (1972) determined the exposure to low energy neutrons.

Other Studies

A wide variety of experiments were performed on Luna 16 samples, because these were among the very first samples of the Moon (*see big book in Cyrillic*). Numerous investigators studied the cosmic-ray induced tracks in grains along the Luna 16 core (Agrawal et al. 1974, Bhandari et al. 1974, Berdot et al. 1972, Phakey and Price 1972, Walker and Zimmerman 1972). Oxygen isotopes were measured by Clayton (1972). Rare gas measurements were made by Heymann et al. (1972), Kaiser (1972), Pepin et al. (1972), Rao et al. (1974), (Vinogradov 1974) and others. As in the case of Apollo, Luna samples were examined by Mossbauer (Malyssheva 1974, Nady et al. 1974), EPR (Marov et al. 1974), ESCA (Vinogradov et al. 1974), Infrared (Akhmanova et al. 1974), cathodoluminescence (Spivak et al. 1974) spectroscopy (*publications in Cyrillic*).

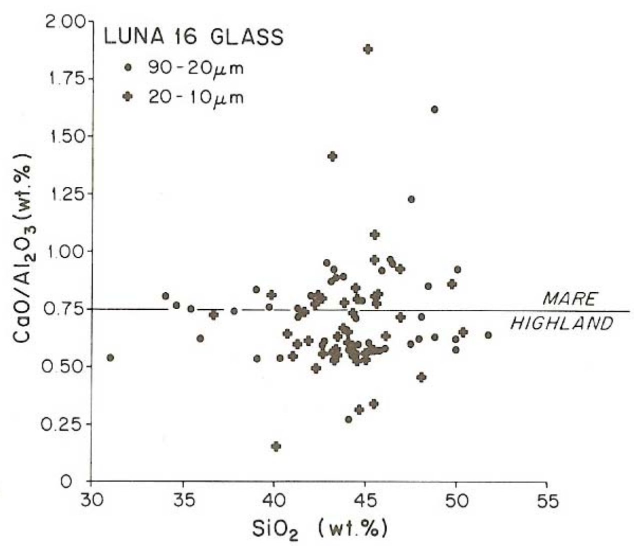


Figure 9: Glass composition as determined by Simon et al. (1991).

Processing

The initial reception and preliminary description of Luna 16 samples was nicely documented by Vinogradov (1974), Surkov et al. (1974) and Stakheyev et al. (1974) *in Cyrillic*. There appear to be two chambers involved - an initial processing cabinet (or vacuum tank) and a round examination cabinet. Samples were processed in an inert gas (N2?) to protect them from moisture, oxygen, and contamination.

Table 1a. Chemical composition of Luna 16 soil.

								McKay					fine	coarse	fine	coarse	
reference	Vinogradov71					Laul81		Sourcebook		Laul72			Hubbard 72				
weight	A	B	C	D		21000,5		ave.		A5	G5		A3	A37	G3	G47	
SiO2 %	41.7	41.2	42.5	41.3	(d)			41.7	(b)				44		45		
TiO2	3.39	3.46	3.3	3.42	(d)	3.5	(a)	3.4	(b)				3.3		3.5		
Al2O3	15.32	15.4	15.45	15.15	(d)	15.5	(a)	15.3	(b)				16		16		
FeO	16.8	16.55	16.3	16.9	(d)	16.5	(a)	16.7	(b)				16		15.9		
MnO	0.21	0.2	0.2	0.22	(d)	0.23	(a)	0.23	(b)				0.23		0.23		
MgO	8.73	8.82	8.96	8.6	(d)	8.1	(a)	8.8	(b)				8.51		8.12		
CaO	12.2	12.8	12.42	12.55	(d)	11.8	(a)	12.5	(b)				12.1		12.1		
Na2O	0.37	0.36	0.36	0.28	(d)	0.38	(a)	0.34	(b)				0.42		0.42		
K2O	0.1	0.12	0.1	0.1	(d)	0.11	(a)	0.1	(b)				0.09		0.11		
P2O5								0.12	(b)								
S %	0.19	0.2	0.18	0.25	(d)			0.21	(b)								
sum																	
Sc ppm	27	33	23.3	25		52	(a)	37	(b)								
V	64	73.5	55.3	55		80	(a)										
Cr	2121	1710	2053	1779	(d)	2526	(a)	1916	(b)								
Co	68	56	44	61		29.6	(a)										
Ni	190	137	250	178		200	(a)			133	132	(e)					
Cu	36	40	35	36						30	27	(e)					
Zn	10	20	33	21.5						24	29	(e)					
Ga	11		5							3.5	3.5	(e)					
Ge ppb											1300	(e)					
As	0.4	0.36	0.6	0.3													
Se	0.45	0.5		0.4						340	370	(e)					
Rb	3	6.3	5.5							1.5	1.9	(e)	1.79	1.84	1.87	1.91	(c)
Sr	90	156		182		260	(a)						278	279	295	303	(c)
Y	45	49	50	56													
Zr	350	334	354	346													
Nb																	
Mo	7	12	3.6	5													
Ru	0.03	0.044	0.01														
Rh		0.004															
Pd ppb	8.6	12		10													
Ag ppb																	
Cd ppb										200	10900	(e)					
In ppb										3	1.9	(e)					
Sn ppb																	
Sb ppb										3.3	4.2	(e)					
Te ppb										40	28	(e)					
Cs ppm										0.068	0.082	(e)					
Ba	42	259	37	48		180	(a)						164	166	171	176	(c)
La	7.3	8	7.4	7.2		11.6	(a)	13	(b)					11.2			
Ce	21	26	24	23		33	(a)						31.2	33.8	32.6	35.5	(c)
Pr	4.5	4.7	4.6	4.5													
Nd	20	28	21	23		26	(a)						23.7	25.8	24.7	27.1	(c)
Sm	5.6	6.8	6.2	6.8		8.25	(a)						7.33	7.75	7.65	8.15	(c)
Eu	1.6	1.2	1.3	1.4		2.15	(a)						1.99	2.15	2.11	2.32	(c)
Gd	6	4.7	4.6	5.8											9.59	10.4	(c)
Tb	0.75	1	0.9	0.9		1.7	(a)										
Dy	5	5.3	5	5		11	(a)						9.79	10.5	10.4	10.8	(c)
Ho	2	2.2	1.9	1.8													
Er	5	5	5	4.7									5.67		5.88		(c)
Tm	0.4	0.4	0.4	0.4		0.9	(a)										
Yb	3.5	3.6	3.5	3.5		5.7	(a)						5.05	5.34	5.26		(c)
Lu	0.28	0.3	0.3	0.3		0.8	(a)										
Hf	1.1	3.6	1.2	1		7.04	(a)										
Ta						0.5	(a)										
W ppb		4.7	5.3														
Re ppb										3.7	3.4	(e)					
Os ppb																	
Ir ppb										9.6	9.8	(e)					
Pt ppb																	
Au ppb	3.3									2.7	2.9	(e)					
Th ppm						1.39	(a)	0.8	(b)								
U ppm						0.4	(a)	0.25	(b)				0.31	0.38		0.39	(c)

technique: (a) INAA, (b) Russian data, (c) IDMS, (d) XRF, (e) RNAA

Table 1b. Chemical composition of Luna 16 soil.

reference	Vinogradov73		Jerome73		Surkov in Jerome73		Philpotts72		
weight	ave						A4 fines	G4 fines	
SiO2 %	41.93	(a)							
TiO2	3.36	(a)	3.6	(c)					
Al2O3	15.33	(a)	15.4	(c)					
FeO	16.66	(a)	16.1	(c)	15.44	(c)			
MnO	0.2	(a)	0.145	(c)	0.18	(c)			
MgO	8.78	(a)							
CaO	12.53	(a)	11.6	(c)					
Na2O	0.34	(a)	0.38	(c)	0.4	(c)			
K2O	0.1	(a)					0.1	0.106	(d)
P2O5	0.12	(a)							
S %	0.21	(a)							
sum									
Sc ppm	37.2	(b)	49	(c)	49	(c)			
V	67.5								
Cr	1836	(b)	1950	(c)	2160	(c)			
Co	41	(b)	30	(c)	34	(c)			
Ni	180	(b)							
Cu	37	(b)							
Zn	33.4	(b)							
Ga	4.5								
Ge ppb	2250								
As	0.41	(b)							
Se	0.36								
Rb	1.9	(b)					1.85	1.9	(d)
Sr	253	(b)					244	271	(d)
Y	70.4	(b)							
Zr	282	(b)					224	227	(d)
Nb	15.9								
Mo									
Ru									
Rh									
Pd ppb									
Ag ppb									
Cd ppb									
In ppb	0.07								
Sn ppb	1.7	(b)							
Sb ppb	0.85	(b)							
Te ppb	0.027								
Cs ppm									
Ba	185	(b)					169	172	(d)
La	13.4	(b)	11.9	(c)	12	(c)			
Ce	40.8	(b)	38.5	(c)	35	(c)	31.2	32.5	(d)
Pr	8.6	(b)							
Nd	35.7	(b)	24	(c)	25	(c)	26.4	26.3	(d)
Sm	15	(b)	7.3	(c)	6.6	(c)	7.98	8.18	(d)
Eu	2.2	(b)	2.3	(c)	1.9	(c)	2.16	2.22	(d)
Gd	10	(b)					10.5	10.5	(d)
Tb	1.2	(b)	1.5	(c)	1.3	(c)			
Dy	12.5	(b)					10.1	10.4	(d)
Ho	2.8	(b)							
Er	5.8	(b)					5.78	5.87	(d)
Tm	0.97	(b)	0.78	(c)	0.71	(c)			
Yb	5.9	(b)	5.4	(c)	4.1	(c)	5.45	5.44	(d)
Lu	1.1	(b)	0.78	(c)	0.63	(c)	0.822	0.841	(d)
Hf	7.8		6.7	(c)	7	(c)		5.88	(d)
Ta									
W ppb									
Re ppb									
Os ppb	30								
Ir ppb	1								
Pt ppb	50								
Au ppb									
Th ppm	0.8		1.2	(c)					
U ppm	0.25								

technique: (a) XRF (b) Russian data by MS, (c) INAA, (d) IDMS

Table 2a. Chemical composition of Luna 16 basalts

reference	Vinogradov		Vinogradov		Albee72		Grieve72			Keil72		Helmke72	
weight	1971		1973		B1		G38/1	G38/2	G38/3			A-31	C-29
SiO2 %	43.8	(a)	42.95	(a)	45.5	(c)	45.17	43.36	44.2	46.6	(d)		
TiO2	4.9	(a)	5.5	(a)	4.04	(c)	2.9	4.37	2.48	6.1	(d)		
Al2O3	13.65	(a)	13.88	(a)	13.95	(c)	16.98	15.13	16.45	15.7	(d)		
FeO	19.36	(a)	20.17	(a)	17.77	(c)	13.21	17.48	13.67	17.2	(d)		
MnO	0.2	(a)	0.2	(a)	0.26	(c)	0.22	0.27	0.2	0.28	(d)	0.083	0.15
MgO	7.05	(a)	6.05	(a)	5.95	(c)	4.02	4.97	4.3	3.7	(d)		
CaO	10.4	(a)	10.8	(a)	11.96	(c)	13.32	12.77	12.65	11.3	(d)		
Na2O	0.38	(a)	0.23	(a)	0.63	(c)	0.69	0.7	0.69	0.46	(d)		
K2O	0.15	(a)	0.16	(a)	0.21	(c)	0.17	0.17	0.21	0.24	(d)	0.07	0.09
P2O5	0.12	(a)	0.14	(a)	0.15	(c)				0.12	(d)		
S %	0.17	(a)	0.17	(a)									
sum													
Sc ppm	20	(b)	31.5	(b)								26	54
V	42.5	(b)	43.8										
Cr	1916	(a)	1904	(b)			550	1574	616	753	(d)	1900	2050
Co	29	(b)	21.7	(b)								21	14
Ni	147	(b)	79	(b)									
Cu	13	(b)	19	(b)									
Zn	26	(b)	23.5	(b)									
Ga	1.2	(b)	3.2									4.3	3.6
Ge ppb			1800										
As	2.9	(b)	1.5	(b)									
Se	0.7	(b)	0.4										
Rb			1.3	(b)									
Sr	445	(b)	433	(b)									
Y	58	(b)	90.5	(b)									
Zr			323	(b)									
Nb			15										
Mo			0.24	(b)									
Ru	6	(b)											
Rh													
Pd ppb	0.027	(b)											
Ag ppb	0.2	(b)	0.053										
Cd ppb													
In ppb			0.012										
Sn ppb	4	(b)	2.3										
Sb ppb	0.5	(b)	0.35										
Te ppb													
Cs ppm	0.75	(b)											
Ba	206	(b)	238									203	243
La	7.7	(b)	11									12	19.4
Ce	24.6	(b)	45									30	66
Pr	4.8	(b)	10										
Nd	25	(b)	32										
Sm	7.1	(b)	9.7									8.1	16
Eu	1.2	(b)	2.2									2.04	4.04
Gd	4.8	(b)	11										17
Tb	0.9	(b)	0.85										3.1
Dy	5.2	(b)	12									8.8	17.9
Ho	2	(b)	2.8										
Er	5	(b)	9.6										12
Tm	0.4	(b)	0.9										
Yb	3.6	(b)	6.2									5.2	10.9
Lu	0.3	(b)	1.3									0.69	1.51
Hf	0.3	(b)										0.46	1.3
Ta													
W ppb													
Re ppb													
Os ppb													
Ir ppb													
Pt ppb													
Au ppb													
Th ppm													
U ppm													

technique: (a) XRF, (b) mass spec, (c) point count/ e probe, (d) broad beam e probe

Table 2b. Chemical composition of Luna 16 basalts

reference	Cimbalnikova 77													
weight													average	
SiO2 %	42.8	35.3	36.8	52	44.1		48.1	46.6		59.1	46			(a)
TiO2	3.17	3.7	3.8	4.2	4.2	3.5	5.3	4.8	5.3	4.8	4.2	6.3	4.6	(a)
Al2O3	16.4	8.7	8.8	8.9	9.3	9.1	13.1	13	12.2	13.6	9.6	13.6	11	(a)
FeO	17.6	25.6	25.7	25.2	23.1	22.5	24.2	19.9	21.6	22.7	17.6	20.7	22.6	(a)
MnO	0.26	0.29	0.28	0.26	0.27	0.23	0.28	0.32	0.27	0.29	0.27	0.29	0.28	(a)
MgO	8.8	5.5	5.6	4.2	4.8	10.3	6.3	8.6	9.5	7.8	7	8.8	7.1	(a)
CaO	12.9	9.1	8.7	8.7	9.4	12.3	12	10.4	11.6	10.9	10.5	13.7	10.7	(a)
Na2O	0.43	0.56	0.66	0.62	0.53	0.4	0.44	0.4	0.46	0.46	0.53	0.46	0.5	(a)
K2O	0.144	0.2		0.26	0.23	0.21	0.17	0.19		0.17	0.18	0.17	0.2	(a)
P2O5														
S %														
sum														
Sc ppm	60	89	83	88	83		70	55	76	70	57		75	(a)
V	90	55	51	68	60	65	89	81	104	89	67	107	76	(a)
Cr	1984	2121	1984	2395	1800	1400	1900	1700	2500	1800	1200	1984	1916	(a)
Co	30	22	27	27	30	30	24	60	25	22		25	29	(a)
Ni														
Cu														
Zn														
Ga														
Ge ppb														
As														
Se														
Rb														
Sr	*350*	*500*	*754*	*741*		*560*	*800*	*1100*		*1000*		*500*	*744*	(b)
Y														
Zr														
Nb														
Mo														
Ru														
Rh														
Pd ppb														
Ag ppb														
Cd ppb														
In ppb														
Sn ppb														
Sb ppb														
Te ppb														
Cs ppm														
Ba	250	280	410	243	294	330	400	400	460	400	420	400	371	(a)
La	15					10	20	20	16	21	22	20	18	(a)
Ce	45	59	79	66	56		65	65	58	70	73	60	65	(a)
Pr														(a)
Nd	40						50	60	70	62	65	60	61	(a)
Sm	7	15	19	17	14	11	15	16	15	15	17	15	15	(a)
Eu	2	5	6	5	5	2	4	3.5	4	5	4.6	4	4.4	(a)
Gd														(a)
Tb	1.7						2.8	2.5	2.5	3	2.5	3	2.7	(a)
Dy	12	17.3	31.6	26	31.9	14	20	24	14	21	26	22	22.5	(a)
Ho	2.2						4	4	3	5	4	4.2	4	(a)
Er														(a)
Tm							2.6	2.8	2.7	1.6	2.4		2.4	(a)
Yb	6						9	9	7	10	9	9	9	(a)
Lu	1						1.5	1.4	1.1	1.5	1.5	1.3	1.4	(a)
Hf							13	10	11	14	13	13	12	(a)
Ta														
W ppb														
Re ppb														
Os ppb														
Ir ppb														
Pt ppb														
Au ppb														
Th ppm	1.1						1.1	1.2		1.2	1.7	1.5	1.3	(a)
U ppm	0.7	0.9								1			1	(a)

technique: (a) INAA (Adam et al. , Czechoslovakia), (b) bogus

Table 2c. Chemical composition of aluminous Luna 16 basalts

reference	Kurat et al. 76													Cimbalnikova 77		
weight																
SiO2 %	46.3	47.3	46.3	46.7	44.6	43.2	44.1	45.6	43.7	42.6	41.3	(a)		51.4	39.6	(b)
TiO2	1.02	2.03	2.16	2.48	3.5	4.8	3.7	3.5	4.8	1.05	1.93	(a)	2.3	4	2.7	(b)
Al2O3	20.2	19	19.3	16	16.5	14.3	14.5	14.2	12.1	19.4	11.5	(a)	16.3	14.2	18.3	(b)
FeO	11.1	12.1	12.9	14.1	15.3	16.4	16.6	17.3	18.8	18.7	21.6	(a)	15.6	14.3	13	(b)
MnO	0.17	0.21	0.2	0.23	0.23	0.27	0.26	0.25	0.3	0.22	0.28	(a)	0.22	0.26	0.2	(b)
MgO	2.32	3.1	3.8	3.7	4.6	4.9	5.2	5.2	6.3	4.1	12	(a)	9.5	8.6	8.5	(b)
CaO	14.8	14.3	15	15.4	14.3	13.4	14.2	13.3	12.2	12.2	9.3	(a)	12.9	12.2	13.6	(b)
Na2O	0.83	0.68	0.52	0.55	0.39	0.47	0.5	0.34	0.45	0.56	0.39	(a)	0.36	0.4	0.33	(b)
K2O	0.44	0.32	0.19	0.25	0.18	0.21	0.24	0.24	0.24	0.29	0.17	(a)		0.14	0.12	(b)
P2O5	0.23	0.13	0.05	0.1	0.02	0.06	0.05	0.11	0.1	0.07	0.05	(a)				
S %																
sum																
Sc ppm													50	55	45	(b)
V													105	105	67	(b)
Cr													2000	1400	1900	(b)
Co													45	100	30	(b)
Ni																
Cu																
Zn																
Ga																
Ge ppb																
As																
Se																
Rb																
Sr															300	(b)
Y																
Zr																
Nb																
Mo																
Ru																
Rh																
Pd ppb																
Ag ppb																
Cd ppb																
In ppb																
Sn ppb																
Sb ppb																
Te ppb																
Cs ppm																
Ba													360	400	310	(b)
La													15	12	13	(b)
Ce													50	35	50	(b)
Pr																
Nd													20	30	26	(b)
Sm													12	10	10	(b)
Eu													4	2.5	2.8	(b)
Gd																
Tb													2	1.3	1.6	(b)
Dy													20	12	14	(b)
Ho													3.5	2	2.8	(b)
Er																
Tm													1.9	1.2	1.6	(b)
Yb													7	6	6	(b)
Lu													1	0.8	0.8	(b)
Hf													8	6	7	(b)
Ta																
W ppb																
Re ppb																
Os ppb																
Ir ppb																
Pt ppb																
Au ppb																
Th ppm													1.1	1.7	1.4	(b)
U ppm																

technique: (a) broad beam e probe, (b) INAA

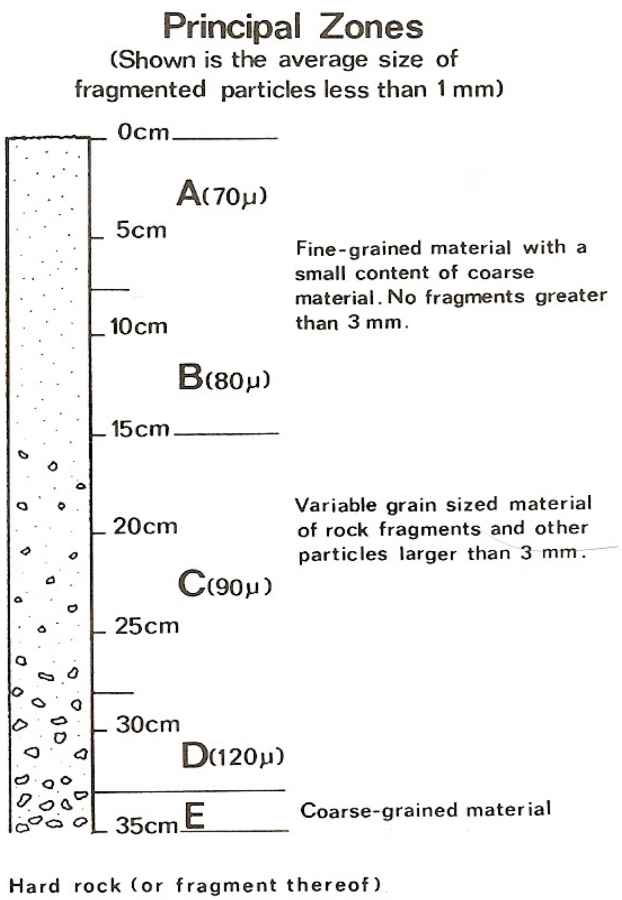


Figure 10: Sketch of Luna 16 core (Vinogradov 1971).

A description of the Luna 16 samples as studied by the US investigators is given on page 223 of EPSL vol. 13. Sample A (1.5 g) was from 6-8 cm A level in core. Sample B was a basalt fragment (62 mg) from the 15 – 28 cm zone. Sample G (1.5 g) was from the 29-31 cm level. The US devised its own numbering system (figures). Additional samples were obtained in 1979 and 1987. Samples were also distributed to other countries (see list).

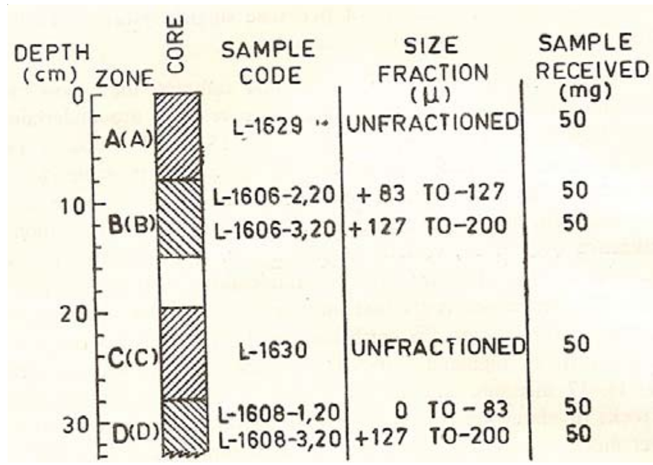
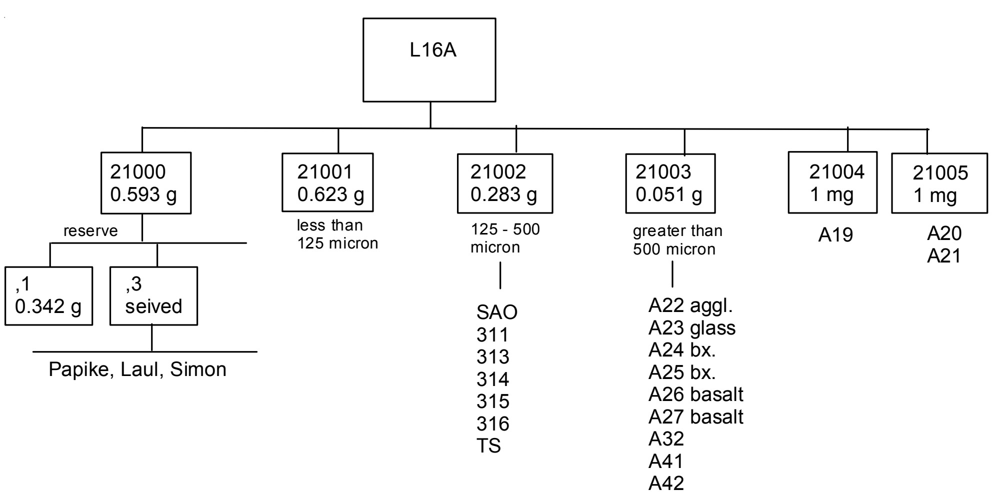


Figure 11: Location and numbering system of six 50 mg samples of Luna 16 samples studied by INAA by Indian researchers (Lal 1974).

Sample A (21000) was sieved and split into 21001-5 according to grain size. Sample G (21010) was also sieved and split into 21011-15. A portion of the unsieved sample A (21000) was separately sieved by the Papike team in 1981.

Sample 21020 is a nice basalt and 21036 is apparently mostly a soil breccia.

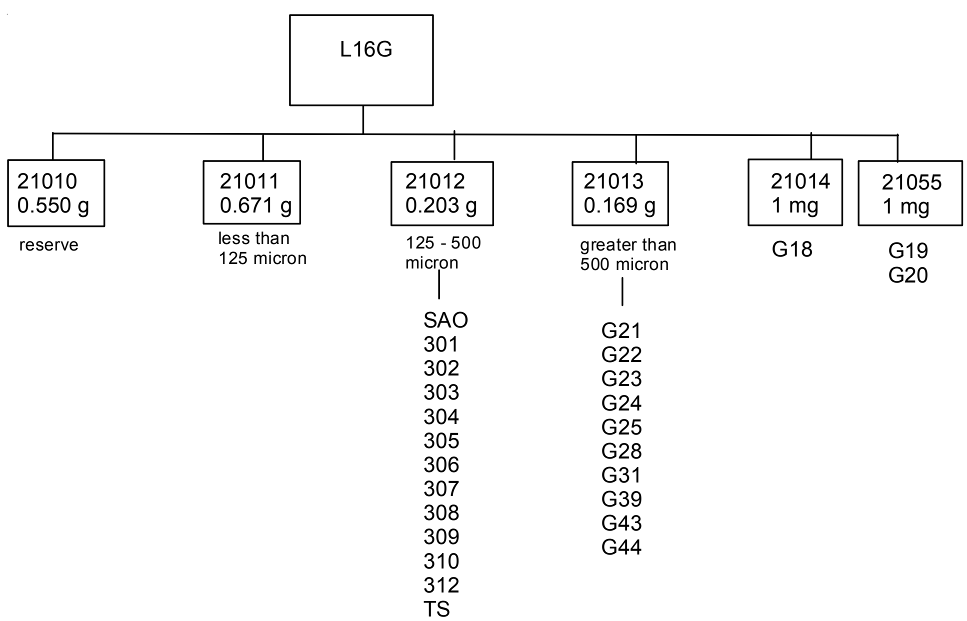
The Smithsonian Institution made 21 very nice thin sections of Luna 16 (see list in Reid et al. 1971). Various investigators made a large number of grain mounts (*there is a need for a Texas style "roundup"*)!.



List of Luna Samples received from USSR as of 9/25/87

Luna16

US number	weight	location		date rec
21000	0.593	6 – 8 cm	7/9/71	(as 1.62 inc. 21001-5)
21001	0.623			
21002	0.283			
21003	0.051			
21004	0.001			
21005	0.7			
21010	0.55	29 – 31 cm	7/9/71	(as 1.593 inc. 21011-15)
21011	0.671			
21012	0.203			
21013	0.169			
21014	0.001			
21015	0.001			
21020	0.062	middle	7/9/71	
21025	0.03	? ?	3/20/79	
21036	0.997	? ?	3/14/87	
L1627	0.5	27 cm zone		Royal Society London
L1629	0.15	0 – 8 zone		India
L1606	0.1	8 – 15 zone		India
L1630	0.15	20 - 28 zone		India
L1608	0.1	28 - 33 zone		India



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