71569

High-Ti Mare Basalt
289.6 g

INTRODUCTION

See "Rake Sample Descriptions" and "Table of Rake Samples", as well as Fig. 1.

PETROGRAPHY AND MINERAL CHEMISTRY

Longhi et al. (1974), and Warner et al. (1975, 1978a,b,f) reported the petrography and mineral chemistry of 71569. Longhi et al. (1974) only briefly mentioned 71569, stating that it is similar to 70215. Warner et al. (1975) described 71569 as a micro-porphyritic ilmenite basalt, but did not specifically mention the petrography and mineral chemistry of this basalt during their study of Apollo 17 rake samples.

During the preparation of this catalog, we examined thin sections 71569,46, ,53, ,57, and ,60. 71569 is a medium-grained (0.1-0.4 mm), porphyritic basalt. Olivine occurs as phenocrysts (up to l mm), as well as rounded cores (~0.05-0.10mm) in larger pyroxenes (up to 0.4mm - Fig. 2). Olivine contains euhedral chromite inclusions (<0.005mm). Ilmenite occurs as phenocrysts (with "sawtooth" margins) up to 1.5mm, as well as a groundmass phase (Fig. 2). Rare rutile and chromite exsolution features were observed in the phenocrystic ilmenite. Pyroxene,plagioclase, and ilmenite form the groundmass. Pyroxene occurs either as feathery or blocky masses. Blocky pyroxene masses usually possess an olivine core. Occasionally plagioclase and pyroxene are intergrown into "bow-tie" structures. Native Fe and troilite (<0.1mm) form interstitial phases. No armalcolite or interstitial SiO_2 was observed.

Figure 1: Hand specimen photograph of 71569,0. Cubic scale = 1 cm^3.

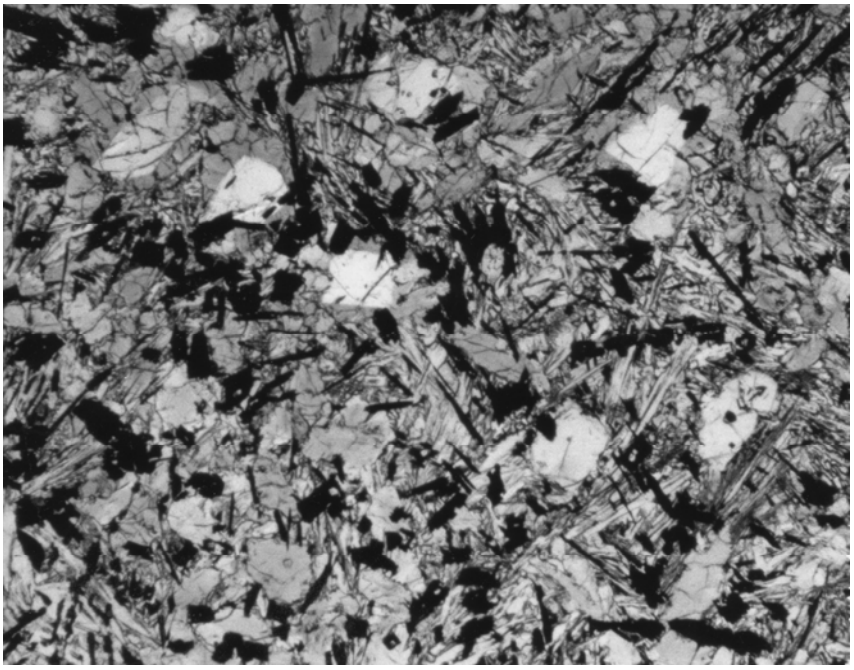

Figure 2: Photomicrograph of 71569,60 showing pyroxene reaction rims around olivine phenocrysts and ilmenite phenocrysts with sawtooth margins. These are set in a sub-variolitic matrix.

WHOLE-ROCK CHEMISTRY

Detailed whole-rock determinations of 71569 have been conducted by Warner et al. (1975) (the same analysis was also reported by Laul et al., 1975), Wanke et al. (1975), and Rhodes et al. (1976) (Table 1). Warner et al. (1975) reported a TiO_2 content in 71569,20 of 13.2 wt%, with a MG# of 47.8. Wanke et al. (1975) analyzed 71569,24 and reported a TiO_2 content of 12.04 wt%, with a MG# of 44.4. Rhodes et al. (1976) defined 71569,11 as a Type A Apollo 17 high-Ti basalt with 11.57 wt% TiO_2 and a MG# of 42.0.

The REE profiles determined by Wanke et al. (1975), Warner et al. (1975), and Rhodes et al. (1976) show good agreement in the LREE (Fig. 3 and Table 1), but exhibit more discrepancy in the middle and heavy REE (Fig. 3). The profile of Rhodes et al. (1976) exhibits a decrease from Gd to Lu, whereas the other two are relatively flat. The analysis of Warner et al. (1975) contains the lowest abundances of the middle and heavy REE (Fig. 3). All are LREE-depleted and contain a negative Eu anomaly. All three

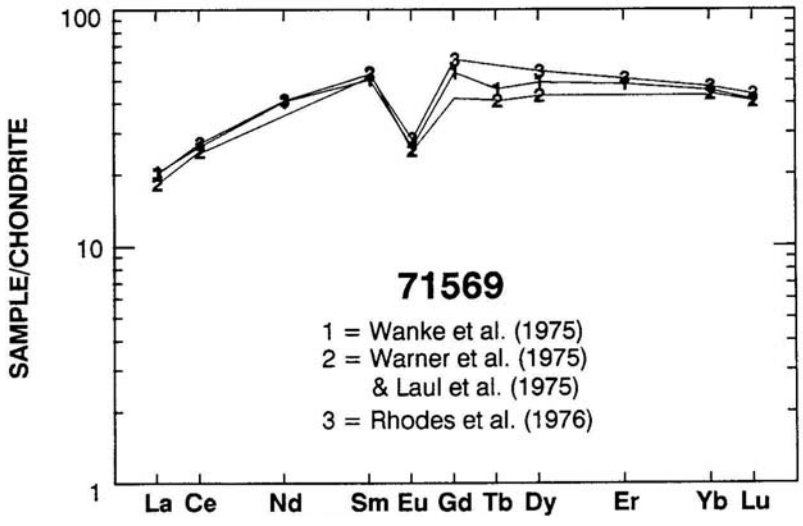

Figure 3: Chondrite -normalized rare-earth element profiles for 71569. The first analysis is from Wanke et al. (1975). The second analysis was reported both by Warner et al. (1975) and Laul et al. (1975). The third analysis was reported by Rhodes et al. (1976).

studies yield $(Eu/Eu^*)_N$ values between 0.50 and 0.53.

Two specialized whole-rock analyses of 71569 have been published. Gibson et al. (1976) reported the sulphur abundance as 2005 ± 40 ugS/g with an equivalent wt% Fe^o of 0.076. Jovanovic et al. (1977) reported the Ru and Os abundances in 71569,37 (Table 1).

RADIOGENIC ISOTOPES

Nyquist et al. (1976) reported the whole-rock Rb-Sr composition of 71569,11 (Table 2). This formed part of a much larger study of Apollo 17 basalt petrogenesis. Nunes et al. (1974) reported the U-Th-Pb systematics for 71569 (Table 3).

COSMOGENIC RADIONUCLIDES & EXPOSURE AGES

Arvidson et al. (1976) reported a Kr-Kr exposure age for 71569 of 134 Ma. Niemeyer et al. (1977) went into more detail with 71569..These authors reported the rare gas isotope composition of 71569,15 (Table 4), as well as exposure ages for this sample using a variety of techniques (Table 5).

EXPERIMENTAL

71569 has been used in a variety of experimental studies. Walker et al. (1975) and O'Hara and Humphries (1975) used 71569 in a crystallization study concerned with the origins of high-Ti basalts. Simmons et al. (1975) used 71569 in a study of microcracks in lunar samples. Finally, Longhi et al. (1978) used 71569 to determine the partitioning of Fe and Mg between olivine and lunar basaltic liquids.

PROCESSING

71569 has been studied extensively and as such, 71569,0 has been entirely subdivided. Numerous sub-samples remain which are of reasonable size (i.e., > 1 g). These, along with thin section numbers, are reported in Table 6.

Table 1: Whole-rock chemistry of 71569.

	Sample ,24 Method X,N Reference 1	Sample ,29 Method N Reference 2	Sample ,11 Method X,N,I Reference 3	Sample ,37 Method N Reference 4
SiO_2 (wt %)	39.38		39.97	
TiO_2	12.04	13.2	11.57	
Al_2O_3	8.58	8.5	9.08	
Cr_2O_3	0.218	0.420	0.36	
FeO	18.96	17.9	18.85	
MnO	0.147	0.220	0.28	
MgO	8.48	9.2	7.66	
CaO	10.58	9.6	11.27	
Na_2O	0.21	0.37	0.41	
K_2O	0.052	0.065	0.06	
P_2O_5	0.013		0.06	
S	0.16		0.19	
K (ppm)			585	
Nb	24			
Zr	258			
Hf	8.70	8.4	9.7	
Ta	1.75	1.7		
U	0.147			
Th				
W	0.079			
Y	91			
Sr	170		195	
Rb	0.74		0.64	
Li	8.1		10.1	
Ba	88		84.4	
Cs	0.041			
Be				
Zn				
Pb				
Cu	4.00			
Ni				
Co	18.6	17.5	18.0	
V		100		
Sc	82.4	73	81	
La	6.82	6.1	6.74	
Ce	23.0	22	23.8	

Table 1: (Concluded).

	Sample ,24 Method X,N Reference 1	Sample ,29 Method N Reference 2	Sample ,11 Method X,N,I Reference 3	Sample ,37 Method N Reference 4
Nd	26.0		26.3	
Sm	10.4	11.1	10.9	
Eu	2.03	1.97	2.19	
Gd	15.1		17.1	
Tb	2.7	2.4		
Dy	17.1	15	19.0	
Er	11.0		11.6	
Yb	10.1	9.8	10.5	
Lu	1.42	1.4	1.50	
Ga	2.15			
F	78.0			
Cl	4.9			
C				
N				
H				
He				
Ge (ppb)				
Ir	4.8			
Au	0.25			
Ru				0.08 ± 0.57
Os				0.4 ± 0.2

Analysis by: N = INAA; X = XRF; I = Isotope dilution.

References: 1 = Wänke et al. (1975); 2 = Warner et al. (1975) and Laul et al. (1975) (same analysis); 3 = Rhodes et al. (1976); 4 = Jovanovic et al. (1977).

Table 2: Rb-Sr composition of 71569.
Data from Nyquist et al. (1976).

	Sample 71569,9
wt (mg)	57
Rb (ppm)	0.638
Sr (ppm)	195
$^{87}Rb/^{86}Sr$	0.0095 ± 2
$^{87}Sr/^{86}Sr^{b}$	0.69979 ± 5
T_B	5.04 ± 0.54
T_L	5.54 ± 0.54

b = Uncertainties correspond to last two figures and are 2 sigma - normalized to $^{88}Sr/^{86}Sr = 8.37521$; B = Model age assuming I = 0.69910 (BABI + JSC bias); L = Model age assuming I = 0.69903 (Apollo 16 anorthosites for T = 4.6 Ga).

Table 3: U-Th-Pb systematics of 71569.
Data from Nunes et al. (1974).

	1	2	3	4	5
wt(mg)	158.6	213.7	158.6		
U (ppm)	0.1176				
Th (ppm)	0.3881				
Pb (ppm)	0.2663				
$^{232}Th/^{238}U$	3.41				
$^{238}U/^{204}Pb$	370				
$^{206}Pb/^{204}Pb$		180.4@	249.6@		
$^{207}Pb/^{204}Pb$		109.8@	149.9@		
$^{208}Pb/^{204}Pb$		176.2@	–		
$^{206}Pb/^{204}Pb$		220.3*	380.2*		
$^{207}Pb/^{204}Pb$		133.7*	225.7*		
$^{208}Pb/^{204}Pb$		210.7*	–		
$^{207}Pb/^{206}Pb$		0.6042*	0.5936*		
$^{208}Pb/^{206}Pb$		0.9564*	–		
$^{206}Pb/^{238}U$				0.9844[a]	1.003[a]
$^{207}Pb/^{235}U$				78.95[a]	80.24[a]
$^{207}Pb/^{206}Pb$				0.5820[a]	0.5808[a]
$^{208}Pb/^{232}Th$				0.2479[a]	–
$^{206}Pb/^{238}U$				4459[b]	4519[b]
$^{207}Pb/^{235}U$				4506[b]	4523[b]
$^{207}Pb/^{206}Pb$				4529[b]	4525[b]
$^{208}Pb/^{232}Th$				4538[b]	–

1 = Elemental concentrations; 2,3 = @ - Observed ratios, * - corrected for analytical blank; 4,5 = a - corrected for blank and primordial Pb, b - single stage ages in Ma.

Table 4: Rare gas and cosmogenic rare gas abundances in 71569.
Data from Niemeyer et al. (1977).

Rare Gases

	^{3}He	^{4}He	^{22}Ne	^{36}Ar	$^{20}Ne/^{22}Ne$	$^{21}Ne/^{22}Ne$	$^{38}Ar/^{36}Ar$	$^{40}Ar/^{36}Ar$
	($\times 10^{-12}$ cm^3 STP/g)							
71569:	78.5 ± 2.5	6100 ± 350	19.18 ± 0.87	10.16 ± 0.51	0.841 ± 0.004	0.8791 ± 0.0038	1.559 ± 0.016	186 ± 1

	^{84}Kr	^{78}Kr	^{80}Kr	^{81}Kr	^{82}Kr	^{83}Kr	^{86}Kr
	($\times 10^{-12}$ cm^3 STP/g)	(^{84}Kr = 100)					
71569:	149.1 ± 7.2	42.50 ± 0.55	109.95 ± 0.79	0.3071 ± 0.0152	169.05 ± 0.85	223.76 ± 1.00	4.14 ± 0.12

	^{132}Xe	^{124}Xe	^{126}Xe	^{128}Xe	^{129}Xe	^{130}Xe	^{131}Xe	^{134}Xe	^{136}Xe
	($\times 10^{-12}$ cm^3 STP/g)	(^{132}Xe = 100)							
71569:	23.8 ± 1.0	49.79 ± 1.26	86.65 ± 1.73	123.5 ± 2.4	171.6 ± 1.9	76.60 ± 0.98	325.8 ± 4.3	21.49 ± 0.39	15.34 ± 0.35

Cosmogenic Rare Gases*

	^{22}Ne	^{38}Ar	^{83}Kr	^{126}Xe	^{78}Kr	^{80}Kr	^{81}Kr	^{82}Kr	^{84}Kr
	($\times 10^{-8}$ cm^3 STP/g)		($\times 10^{-12}$ cm^3 STP/g)		(^{83}Kr = 100)				
71569:	18.9	15.7	333	19.9	19.0 ± 0.3	49.2 ± 0.5	0.134 ± 0.007	75.4 ± 0.5	43.7 ± 4.5

	^{124}Xe	^{128}Xe	^{129}Xe	^{130}Xe	^{131}Xe	^{132}Xe	^{134}Xe
	(^{126}Xe = 100)						
71569:	59 ± 2	144 ± 3	157 ± 3	84 ± 2	351 ± 7	69 ± 2	5 ± 1

* Cosmogenic Ne and Ar abundances are calculated from the total gas amounts assuming trapped Ne and Ar of solar composition and cosmic ratios of $^{20}Ne/^{22}Ne \sim 0.8$, $^{21}Ne/^{22}Ne \sim 0.9$, and $^{36}Ar/^{38}Ar \sim 0.6$. Both Kr and Xe isotopic compositions are derived from the 1650°C data which was blank corrected only for hydrocarbon contamination. The cosmogenic Kr spectra are calculated assuming $(^{86}Kr/^{83}Kr) = 0.15 \pm 0.15$ and trapped Kr of terrestrial composition. The cosmogenic Xe spectra are deduced assuming $(^{136}Xe/^{126}Xe) = 0.0032 \pm 0.0016$, a terrestrial composition for the trapped Xe, and fissiogenic Xe from in situ spontaneous fission of U for 3.8 Ga.

Table 5: Cosmic ray exposure ages (Ma). Data from Niemeyer et al. (1977).

Method	Sample 71569
^{81}Kr-Kr	134 ± 7
^{3}He	79
^{21}Ne	151
^{38}Ar	125
^{83}Kr	174
^{126}Xe	198

Table 6: Sample numbers of 71569 sub-samples > 1g and thin section numbers. Note that thin section numbers on the same line do not necessarily mean that this thin section was taken from the sub-sample weighing > lg. This lay-out is purely for presenting the information.

Sample	Weight (g)	Thin Section
,1	173.4	,46
,2	36.5	,53
,3	3.70	,54
,4	12.7	,55
,6	6.00	,56
,7	2.75	,58
,8	2.23	,59
,9	2.10	,60
,10	7.00	,61
,11	1.40	,62
,12	7.10	,63
,15	1.30	,64
,16	4.90	,65
,17	2.32	
,24	1.00	
,24	2.27	
,26	2.40	
,28	10.5	