70017

High-Ti Mare Basalt
2957 g, 18 x 14 x 10 cm

INTRODUCTION

70017 is a coarse-grained high-Ti basalt. It has been one of the most widely studied of the returned lunar samples. In hand specimen, it is a tough, brownish-gray basalt with a blocky subangular shape. All surfaces are hackly with a few small glass patches. 70017 was originally described as a "holocrystalline, equigranular basalt containing some poikilitic plagioclase"(Apollo 17 Lunar Sample Information Catalog, 1973). The sample comprises 10-15% vugs (Fig. 1), in which mainly pyroxene with minor plagioclase are present. Plagioclase decreases in abundance towards these vugs. Zap pits occur mainly on B and adjacent parts of N, E, S, and W. There are none on T, which was buried. Whole-rock chemistry verifies it as a high-Ti basalt, containing 12-13.5 wt% TiO_2 (Table 1), and dating by Rb-Sr and K-Ar suggests a crystallization age of 3.7-3.8 Ga. Sample 70017 was collected near the Apollo 17 lunar module with 70011, 70012, and 70018.

PETROGRAPHY AND MINERAL CHEMISTRY

70017 has been classified as a plagioclase-poikilitic ilmenite basalt (Papike et al., 1974), a Type 1B of Brown et al. (1975) and Warner et al. (1975), or a Type III of Papike et al. (1973) and Brown et al. (1973). Longhi et al. (1974) described 70017 as a medium-grained hypidiomorphic-granular high-Ti basalt with large, equant, subhedral clinopyroxenes enclosing embayed ilmenites. Plagioclase is anhedral and poikilitically

Figure 1: Hand specimen photograph of 70017,0.

encloses clinopyroxene, olivine, and ilmenite. Euhedral to subhedral ilmenite (~0.5mm) is enclosed in a matrix of clinopyroxene, which is poikilitically enclosed in plagioclase (up to 2mm long). Only minor olivine (~0.2mm) is present as cores of pyroxenes or as euhedral grains poikilitically enclosed in plagioclase. Small (<0.4mm) areas of silica occur as an interstitial phase. Minor chromite, ulvospinel, and rare interstitial glass are also present. Modal analyses have been reported by Brown et al. (1975) from 70017,109 and are 0.9% olivine, 22.8% opaques, 25.4% plagioclase, 49.3% clinopyroxene, 1.3% silica, 0.3% mesostasis. Roedder and Weiblen (1975) reported the modal mineralogy of 70017 as: 57.6% pyroxene; 19.8% plagioclase; 19.2% oxides; a trace of native Fe and sulfides; 1.6^{0}1o silica; 1.4% melt/ mesostasis; and 0.4% olivine.

Pyroxenes zone from subcalcic titanaugites (up to 3.6 wt% TiO_2) to Mg-pigeonites, due to the resorption of olivine (Brown et al., 1975). Later pyroxene compositions approach pyroxferroite (Fig. 2). Sung et al. (1974) reported Ti^3 +/Ti^4 + ratios in clinopyroxenes from 70017 as indicators of oxygen fugacity and/or depth of origin - up to 40% of the Ti present in 70017 pyroxenes is in the trivalent state. Olivine compositions range from Fo_{58} to Fo_{68}, and are relatively rich in Cr_2O_3 (up to 0.5 wt%; Brown et al., 1975). Plagioclase exhibits little zonation, commonly less than 10 An units from core-to-rim. Ilmenites often exhibit small (<0.005mm wide) exsolution lamellae of rutile and some blebs (<0.01mrn) of native Fe. This reaction, in addition to the breakdown of ulvospinel to ilmenite + Fe metal, was reported by El Goresy and Ramdohr (1915) as evidence for an endogenic late-stage reducing gas mixture during the crystallization of this basalt. Ilmenites are generally equant, almost amoeboidal (Papike et al., 1974). The Mg# of ilmenite is approximately 10-12, with Cr_2O_3 never exceeding 1 wt%. Roedder and Weiblen (1975) reported both high-K (6.27 wt% K_2O) and anomalous low-K (0.037 wt% K_2O) melt inclusions in the ilmenites of 70017. The high-K inclusions were attributed to late-stage, silicate-liquid immiscibility, but the origin of the low-K inclusions is obscure.

We found no armalcolite in the thin sections we studied (455 and ,456), although a tan armalcolite has been reported by El Goresy et al. (1974) and Taylor and Williams (1974). E1 Goresy et al. (1974) concluded there were two types of titaniferous basalt present at Apollo 17 on the basis of crystallization sequence. 70017 falls into Type l of their classification. E1 Goresy and Ramdohr (1975) studied the opaque minerals of 70017 in order to determine the nature of subsolidus reduction in lunar basalt petrogenesis.

Pearce and Timms (1992) used laser interference microscopy to examine the plagioclase, and found no fine-scale zoning in any of the grains observed in 70017.

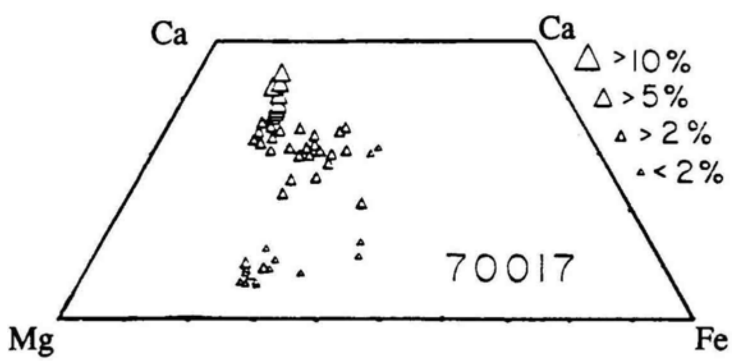

Figure 2: Pyroxene compositions of 70017 represented on a pyroxene quadrilateral.

WHOLE-ROCK CHEMISTRY

Rhodes et al. (1976) considered 70017 too coarse-grained for reliable chemical classification with the subsample size used. The relatively coarse grain size of 70017 introduced the problem of sampling errors. This may account for the fact that 70017 does not conform to the A, B, or C groups of Rhodes et al. (1976). Eleven whole-rock analyses have been reported for 70017 (Table 1). A variety of analytical methods have been employed, including XRF, INAA, and isotope dilution. The major-element compositions are similar for the seven subsamples analyzed for these elements (Rhodes et al., 1974; Brunfelt et al., 1974; Duncan et al., 1974; Miller et al., 1974; Nava, 1974; Rose et al., 1974). Sampling errors may be more apparent in the trace elements.

Table 1: Whole rock analyses of basalt 70017.
[Part A]

Ref.	1	2	3	4	5	6
	,18	,35	,35	,21	,28	,23
SiO_2 (wt%)	38.37	38.07			38.52	38.8
TiO_2	12.83	13.10		13.58	12.21	12.44
Al_2O_3	8.78	8.79		9.47	9.07	9.73
Cr_2O_3	0.577			0.518		0.45
FeO	18.71	18.07		18.32	18.19	17.6
MnO	0.247	0.27		0.254	0.233	0.232
MgO	9.41	9.81		9.13	11.95	9.89
CaO	10.43	10.30		11.48	10.36	10.04
Na_2O	0.43	0.40		0.405	0.405	0.43
K_2O	0.047	0.04		0.044		0.036
P_2O_5	0.052	0.05				0.048
S	0.175	0.15				
Nb (ppm)	18.5					
Zr	218		177			
Hf				8.0		
Ta						
U			0.06	0.088		
Th			0.198	0.17		
W				0.075		
Y	71.2					
Sr	166		153	127		
Rb	1.2		0.299	0.4		
Li			8.1			
Ba	83		45.8	55		
Cs				0.03		
Be						
Zn	<2			2		
Pb						
Cu	<3			2.8		
Ni	<3			<10		
Co	18			20.6		
V	146			156		
Sc				87		
La			3.99	4.11		
Ce			11.3	13.5		
Nd			13.2			

Table 1: (Continued)
[Part A, Concluded]

Ref.	1	2	3	4	5	6
	,18	,35	,35	,21	,28	,23
Sm			5.67	7.53		
Eu			1.49	1.77		
Gd			9.05			
Tb				1.77		
Dy			10.7	13.8		
Er			6.46			
Yb			5.98	6.3		
Lu				1.15		
F						
Cl						
C						
N						
H						
He						
Ga (ppb)				3.1		

Table 1: (Continued)
[Part B]

Ref.	7	8	8	9	9	10	11
	,23	,30	,50	,474	,474	,35	,13
SiO_2 (wt%)		38.80	38.68				
TiO_2		12.84	13.75				
Al_2O_3		8.54	7.40				
Cr_2O_3		0.49	0.49	0.58	0.54		
FeO		18.12	18.77		17.5		
MnO		0.24	0.25				
MgO		10.16	10.45				
CaO		10.56	10.05	7.14	13.4		
Na_2O		0.33	0.34	0.32	0.43		
K_2O		0.07	0.07				
P_2O_5		0.04	0.04				
S							
Nb (ppm)		23	18				
Zr	223	254	250		138		

Table 1: (Continued)
[Part B, Continued]

Ref.	7 ,23	8 ,30	8 ,50	9 ,474	9 ,474	10 ,35	11 ,13
Hf				7.4	6.0		
Ta				1.8	1.5		
U							0.0730
Th				4.8	0.14		0.2204
W							
Y	94	100					
Sr	168	217	155	172	306	153	
Rb	0.280	0.9	0.7			0.299	
Li	8.57	7.8	7.8				
Ba	43	250	180	78	68		
Cs							
Be		<1	<1				
Zn		<4	<4				
Pb		<2	<2				0.1514
Cu		28	84				
Ni		<1	24				
Co		32	32	132	22		
V		98	80		288		
Sc		80	77	75	78		
La		<10	<10	4.6	4.4		
Ce	10.7			16	15		
Nd	12.1			20	14		
Sm	5.13			6.7	71		
Eu	1.62			1.6	1.7		
Gd							
Tb				2.5	2.0		
Dy	10.2						
Er	6.31			0.71			
Yb	6.25			8.2	6.9		
Lu	0.954			1.3	1.1		
F							
Cl							
C							
N							

Table 1: (Concluded) [Part B, Concluded]

Ref.	7	8	8	9	9	10	11
	,23	,30	,50	,474	,474	,35	,13
H							
He							
Ga (ppb)		5.8	5.4	21			
Ge				1.7	1.9		

References: 1) Duncan et al. (1974); 2) Rhodes et al. (1974); 3) Shih et al. (1975); 4) Brunfelt et al. (1974); 5) Miller et al. (1974); 6) Nava (1974); 7) Philpotts et al. (1974); 8) Rose et al. (1974); 9) Dickinson et al. (1989); 10) Nyquist et al. (1975); 11) Mattinson et al. (1977).

Analytical Methods Employed: 1) XRF; 2) XRF; 3) Isotope Dilution and INAA (for Co and Sc); 4) INAA; 5) INAA; 6) Semi-micro Combined Atomic Absorption and Colorimetric Spectophotometry; 7) Isotope Dilution; 8) XRF and optical emission; 9) INAA; 10) Isotope Dilution; 11) Isotope Dilution.

For example, the REE profiles (Fig. 3) of Philpotts et al. (1974) and Shih et al. (1975) have similar HREE abundances, but the REE profile of Brunfelt et al. (1974), while possessing the same overall pattern as the previous two, exhibits elevated REE abundances (Fig. 3). All three analyses exhibit LREE-depleted profiles with a negative Eu anomaly ($[Eu/Eu^*]_N$ = 0.6-0.7). There is a slight decrease in the HREE abundances relative to those of the MREE.

Most of the papers written concerning the whole-rock chemistry involve analyses o£ a suite of Apollo 17 high-Ti basalts, in order to deduce the petrogenesis and source region(s) of the original magmas (Duncan et al., 1974; Rhodes et al., 1974; Shih et al., 1975; Brunfelt et al., 1974; Nyquist et ,it., 1975; Mattinson et al., 1977). Other geochemical studies quoting the whole-rock composition of 70017 were investigations into the nature of the lunar regolith (Miller et al., 1974; Nava, 1974; Rose et al., 1974; Philpotts et al., 1974; Rhodes et al., 1976).

Dickinson et al. (1988,1989) used 70017,474 in a study of the germanium abundances (analyzed by RNAA) of mare basalts, in order to gain an insight into the origin and early evolution of the Moon and lunar basalts. Dickinson et al. (1988) only reported the Ge abundance, whereas Dickinson et al. (1989) report two whole-rock analyses from splits of 70017,474. These whole-rock analyses are similar (Table 1), except for Sm and Th in the first and Sr in the second are high, and these analyses have large errors associated with them. The REE profiles are LREE-depleted (Fig. 3) and have a negative Eu anomaly ($[Eu/Eu^*]_N$ - 0.6). The reported abundance of Ge in 70017 is 1.7 to 1.9 ppb. Dickinson et al. (1988, 1989) concluded that Apollo 17 basalts contain similar Ge abundances to those from the Apollo 11, 12, and 15 sites. The small variations observed are uncorrelated with other siderophile elements and cannot be explained by differences in the amount of metal segregated into the lunar core. Dickinson et al. (1988, 1989) suggested that volatile Transfer of Ge by halogen-rich fluids may have generated such variations.

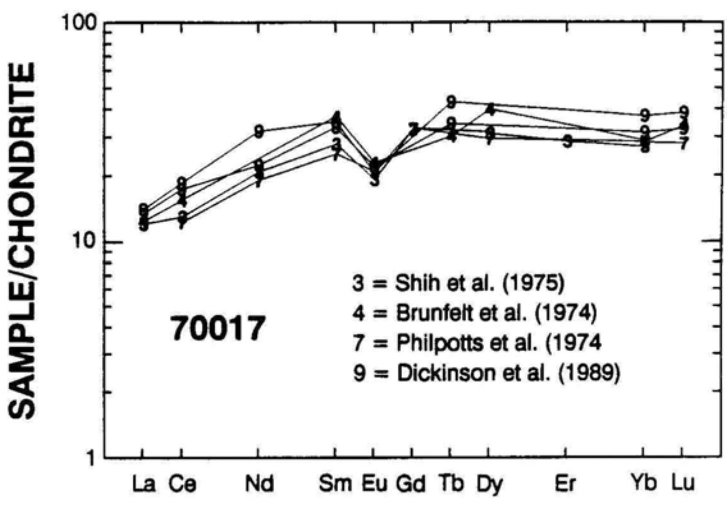

Figure 3: Chondrite -normalized rare-earth element profiles of 70017.

RADIOGENIC ISOTOPES

Basalt 70017 has been analyzed for Rb-Sr (Nyquist et al., 1975), K-Ar and Ar-Ar (Phinney et al., 1975), Oxygen (Mayeda et al., 1975), ^{22}Na-^{26}A1(Yokoyama et al., 1974), Carbon and Sulfur (Petrowski et al., 1974), Kr-Ar exposure ages (Horz et al., 1975), and U-Pb (Mattinson et al., 1977). Results of these studies are summarized in Table 2. The Rb-Sr study of Nyquist et al. (1975) reported an age of 3.68±0.18 Ga with an initial ^{87}Sr/^{S6}Sr ratio of 0.69920 ± 4 (Fig. 4). These authors suggested that a three stage evolution model best accounted for the Sr isotope data: 1) evolution of ^{87}Sr/^{86}Sr in an environment with Rb-Sr > basalts; 2) production of source regions with lower but variable Rb-Sr between 4.6-3.75 Ga; and 3) extraction of these lavas at 3.75 Ga. However, the extreme requirements on analytical precision prevented definitive conclusions. The K-Ar and Ar-Ar study of Phinney et al (1975) was concerned purely with age determinations. These authors reported ^{39}Ar-^{40}Ar and K-Ar ages of 3.80 ± 0.03 and 3.63 ± 0.03 Ga, respectively (Table 2).

The U-Pb study of Mattinson et al. (1977) demonstrates that 70017 has witnessed a some-what different evolution from other Apollo 17 basalts (i.e., source region developed later in a two-stage model). U-Pb data for 70017 whole-rock and mineral separates plot along a chord which intersects the growth curve at 3.7 and 4.33 Ga. The 70017 data appear to plot on a different chord from 75055 and 75035, although the maximum errors on these data allow the possibility that all three plot on a common chord. This common chord corresponds to a crystallization age of 3.8 Ga and an initial radiogenic $^{207}Pb/^{206}Pb$ of 1.41. These authors cite the role of ilmenite in the fractionation of U from Th in the source regions, in order to explain the Pb isotope systematics of 70017. The results presented by Mattinson et al_ (1977) are also reported by Chen et al. (1979) in order to compare with Pb isotope results from 71055.

STABLEISOTOPES

The oxygen study of Mayeda et al. (1 975) demonstrated the uniformity of 5180 values at the Apollo 17 site and reported 5 ^{18}0 values for mineral separates from 70017 (Table 2). This study was basically comparing ^{18}O compositions over the entire moon, noting little difference in oxygen isotope compositions between sites. Mayeda et al. (1975) attribute the lack of fractionation to the absence of water on the Moon.

A similar study was undertaken for carbon and sulfur in 70017 by Petrowski et al. (1974). These authors mainly concentrated upon S, presenting evidence for a complex lunar S cycle. However, whole-rock carbon (Table 2) and abundances of S are also reported by Petrowski et al. (1974) and are given in Table 2.

EXPOSURE AGE

Yokoyama et al. (1974) analyzed Apollo 17 rocks for ^{22}Na and 26A1 isotopes, determining that 70017 is saturated in ^{26}A1 activity. The Ar exposure age of 70017 has been reported as approximately 126 Ma by Horz et al. (1975), which is at variance with the ^{38}Ar-Ca age reported by Phinney et al. (1975) of 220±20 Ma. Phinney et al. (1975) also reported the K and Ca contents (640 ppm and 8.4%, respectively) and the Ar isotopic ratios of 70017 ($^{36}Ar/^{40}Ar$ = 0.006244 ± 0.000088; 37Ar/^{4}0Ar = 0.889 ± 0.018; $^{38}Ar/^{40}Ar$ = 0.00945 ± 0.00012; $^{39}Ar/^{40}Ar$ = 0.007285 ± 0.000085; ^{40}Ar * 10-8 cc STP/g = 2724 ± 20).

MAGNETIC STUDIES

Sample 70017 has been analyzed in a number of magnetic studies in order to deduce the Fe0/Fe^{2}+ ratio by Mossbauer spectroscopy and magnetic measurements (Huffman et al., 1974; Brecher et al., 1974). These authors reported Fe^{o}/Fe^{2}+ ratios of 0.029 and 0.01, respectively. Schwerer and Nagata (1976) reported the magnetic properties of 70017 as a ratio of the isothermal remnant magnetization - IR, to the saturation magnetization

Nyquist et al., 1975

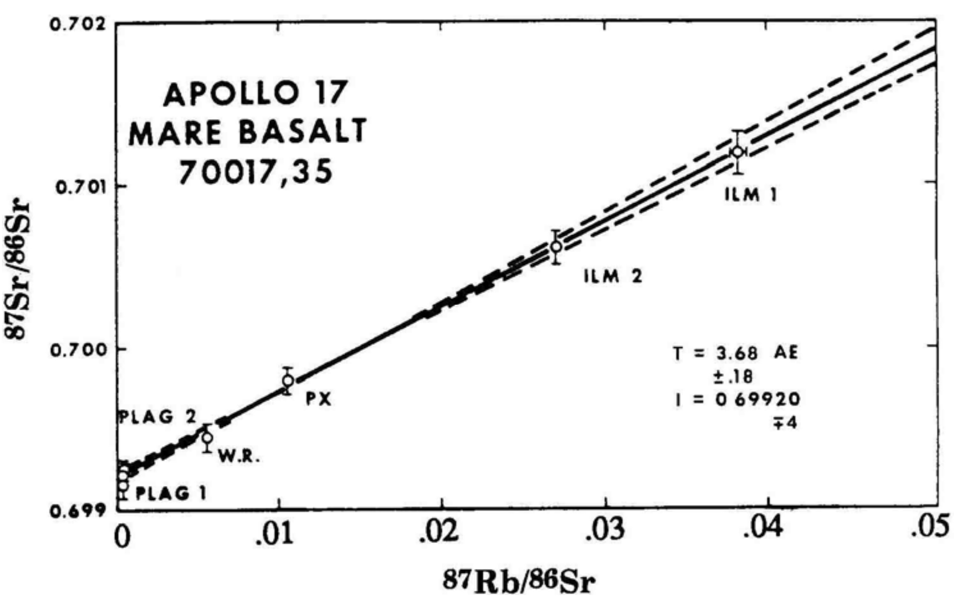

Figure 4: Rb-Sr isochron plot of 70017,35. Taken from Nyquist et al. (1975).

Table 2: Isotope analyses of basalt 70017.

Rb-Sr (Nyquist et al., 1975)

	wt(mg)	Rb (ppm)	Sr (ppm)	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
70017,35	46.0	0.299	153.0	0.00565 ± 23	0.69945 ± 9
plag 1	4.2	0.070	528.7	0.00038 ± 2	0.69916 ± 8
ilm 1	6.8	0.410	31.3	0.0379 ± 5	0.70119 ± 13
px1	6.8	0.115	31.6	0.01050 ± 13	0.69979 ± 9
plag 2	7.1	0.0769	561.0	0.00039 ± 14	0.69922 ± 10
repeat					0.69925 ± 5
ilm 2	10.0	0.2833	0.44	0.0269 ± 3	0.70061 ± 10

AGE = 3.68 ± 0.18 AE, I = 0.69920 ± 4

K-Ar and Ar-Ar (Phinney et al., 1975)

	$^{39}Ar/^{40}Ar$	K-Ar	^{38}Ar-Ca Exposure Age
70017,65	3.80 ± 0.03AE	3.63 ± 0.03AE	220 ± 20 m.y.

Oxygen (Mayeda et al., 1975)

70017,27	Plagioclase	Pyroxene	Ilmenite
^{18}O	5.82	5.27	3.99

Carbon (Petrowski et al., 1974)

	C ppm	^{13}C o/oo PDB
70017,64	22	-22.1

Sulfur (Petrowski et al., 1974)

	S ppm	^{34}S o/oo CDT
70017,64	2283	+ 1.4

U-Pb (Mattinson et al., 1977)

	wt (mg)	Pb	U	Th	$^{238}U/^{204}Pb$ (u)	$^{232}Th/^{238}U$ (k)
70017,13	60.7	0.1514	0.0730	0.220	423	43.12
Px 1	26.5	0.0391	0.0732	0.2200	379	3.10
Px 2	18.5	0.1553	0.0855	0.2584	399	3.12
Px 3	10.2	0.0599	0.0275	0.0857	171	3.22
Ilm 1	16.8	0.2189	0.1252	0.2601	283	2.09
Ilm 2	20.8	0.3036	0.1749	0.4008	357	2.37
Plag 1	47.5	0.0284	0.00516	0.01590	69.1	3.10
Plag 2	48.2	0.0282	0.00467	0.01300	42.6	2.87

Table 2: (Concluded).

		wt (mg)	Observed Ratios $^{208}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	$^{204}Pb/^{206}Pb$	Corrected Ratios $^{208}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	$^{204}Pb/^{206}Pb$
WR A	IC*	60.7	0.9499	0.5587	0.006530	0.8907	0.5443	0.004018
	ID*	54.6	7.369	0.5502	0.005710	.--	0.5467	0.004346
WR B	IC	29.3	0.8546	0.5372	0.003310	0.8281	0.5291	0.002206
Px 1	IC	29.2	0.9692	0.5175	0.005933	0.9048	0.4990	0.003111
	ID	26.5	6.696	0.4994	0.005206	.--	0.4860	0.002874
Px 2	IC	19.2	0.8969	0.5030	0.00547	0.8288	0.4838	0.002642
	ID	18.5	8.082	0.5097	0.00564	.--	0.4940	0.002768
Px 3	IC	11.5	1.2052	0.5980	0.01671	0.9729	0.5348	0.006637
	ID	10.2	26.437	0.5976	0.01880	.--	0.5275	0.005799
Ilm 1	IC	17.8	0.7717	0.5287	0.00710	0.6808	0.5075	0.00382
	ID	16.8	6.070	0.5076	0.00522	.--	0.4959	0.00308
Ilm 2	IC	22.8	0.7150	0.4994	0.00383	0.6936	0.4941	0.00304
	ID	20.8	3.865	0.4979	0.00386	.--	0.4939	0.00305
Plag 1	IC	43.5	1.147	1.0368	0.01531	0.9779	1.0769	0.00819
	ID	47.5	18.70	0.953	0.0139	.--	1.0050	0.00764
Plag 2	IC	48.3	1.346	0.9956	0.02324	1.1010	1.0557	0.01279
	ID	48.2	19.26	0.9736	0.01636	.--	1.0315	0.01054

* IC = determination of isotopic composition; ID = concentration. ID failed for WR B.

- I_s, as well as the $Fe^o/Fe^{2}+$ ratio. The I_R/I_S ratio was determined between 4.2 and 300K. Two determinations were reported by Schwerer and Nagata (1976) for 70017. The $1_R/I_S$ ratio at 4.2K was reported as 0.033 and 0.046, and at 300K was 0.0048 and 0.0068. The FeO/Fe^{2+} ratio was given as 0.0054. The strength of the lunar magnetic field at the time of basalt eruption was reported as Natural Remnant Magnetism (NRM) by Nagata et al. (1974), Stephenson et al. (1974), and Brecher et al, (1974). All authors concluded that 70017 has a reasonable amount of NRM (~10^{-6} emu/g). Stephenson et al. (1974) reported an initial NRM of 51.6 x 10^{-6} G cm^3 g^{-1}. Nagata et al. (1974) reported that 70017 has magnetic properties similar to those of Apollo 11 mare basalts, except for a considerably smaller value of the initial magnetic susceptibility. Furthermore, the thermomagnetic curves in the low-temperature range (4.2-295K) demonstrated that 70017 contains a considerable amount of antiferromagnetic ilmenite. One study (Nagata et al., 1975) included 70017 in an investigation of meteorite impact on the magnetic properties of Apollo lunar materials.

EXPERIMENTAL

Experimental studies involving 70017 include the determination of the liquid line of descent and crystallization sequence (Rutherford et al., 1974; Hess et al., 1975; Hodges and Kushiro, 1974; Lofgren et al., 1975). The studies by Rutherford et al. (1974) and Hess et al. (1975) also centered on the ultimate immiscibility of the residual magma after extreme fractional crystallization. These authors determined that the development of immiscibility in the residual silicate liquid, after ~95% fractional crystallization, depends upon the cooling rate and and the final temperature in the experimental cooling cycle.

Hodges and Kushiro (1974) attempted to use 70017 in order to determine the differentiation sequences in model Moon compositions and, in doing so, presented a detailed crystallization sequence for 70017. These authors proposed the following crystallization sequence: spinel, olivine, armalcolite, followed by the nearly simultaneous crystallization of plagioclase and pyroxene. Ilmenite was the last major phase to form,

Sato (1976a, b) used the solid-electrolyte method (in the temperature range of 100-1200°C) to measure the oxygen fugacity of 70017,31. He determined that the fO_2 values of 70017, 31 are only slightly higher (up to 0.15 log fO_2 unit) than the average of four Apollo 12 and 15 basalts. In terms of bulk rock fO_2, Sato (1976a, b) concluded that 70017 is indistinguishable from low-Ti mare basalts. The "FeO" activity values of 70017 also fall within the range of low-Ti mare basalts. The low Fe^o activity values determined experimentally for 70017 were explained by Sato (1976a, b) as a result of the formation of Fe-FeS melt. Nash and Haselton (1975) reported the silica activity of 70017 to be ~0.3 log a SiO_2 units at 1140°C and concluded that this basalt crystallized slowly under equilibrium conditions.

Osborne et al. (1978) used 70017 in an experimental study of spectral reflectance for Ti determinations at room and elevated temperatures. High-temperature measurements revealed that slopes of the reflectance profiles in the 0.400-0.550 um region increased significantly up to 300 °C, demonstrating a decrease in intensity at elevated temperatures as a result of metal - metal (e.g., Fe2+ to Ti^{4}+) charge transfer bands involving Ti. They concluded that techniques for mapping Ti concentrations on hot planetary surfaces should be applied cautiously if room-temperature calibration spectra are used.

PROCESSING

The initial dissection of 70017 is detailed, with subsample numbers, in Fig. 5. 70017,0 has been entirely subdivided, with 70017,8 being the largest portion left (1450.28). As much work has been conducted on 70017, we report the many thin-section numbers (Table 3).
Table 3. Thin section numbers from 70017.

Table 3: Thin section numbers from 70071.

,1-6	,210-216
,107-119	,217-220
,128-132	,223-224
,157-161	,235
,194-195	,455-456
,200-201	,473
,206-207	

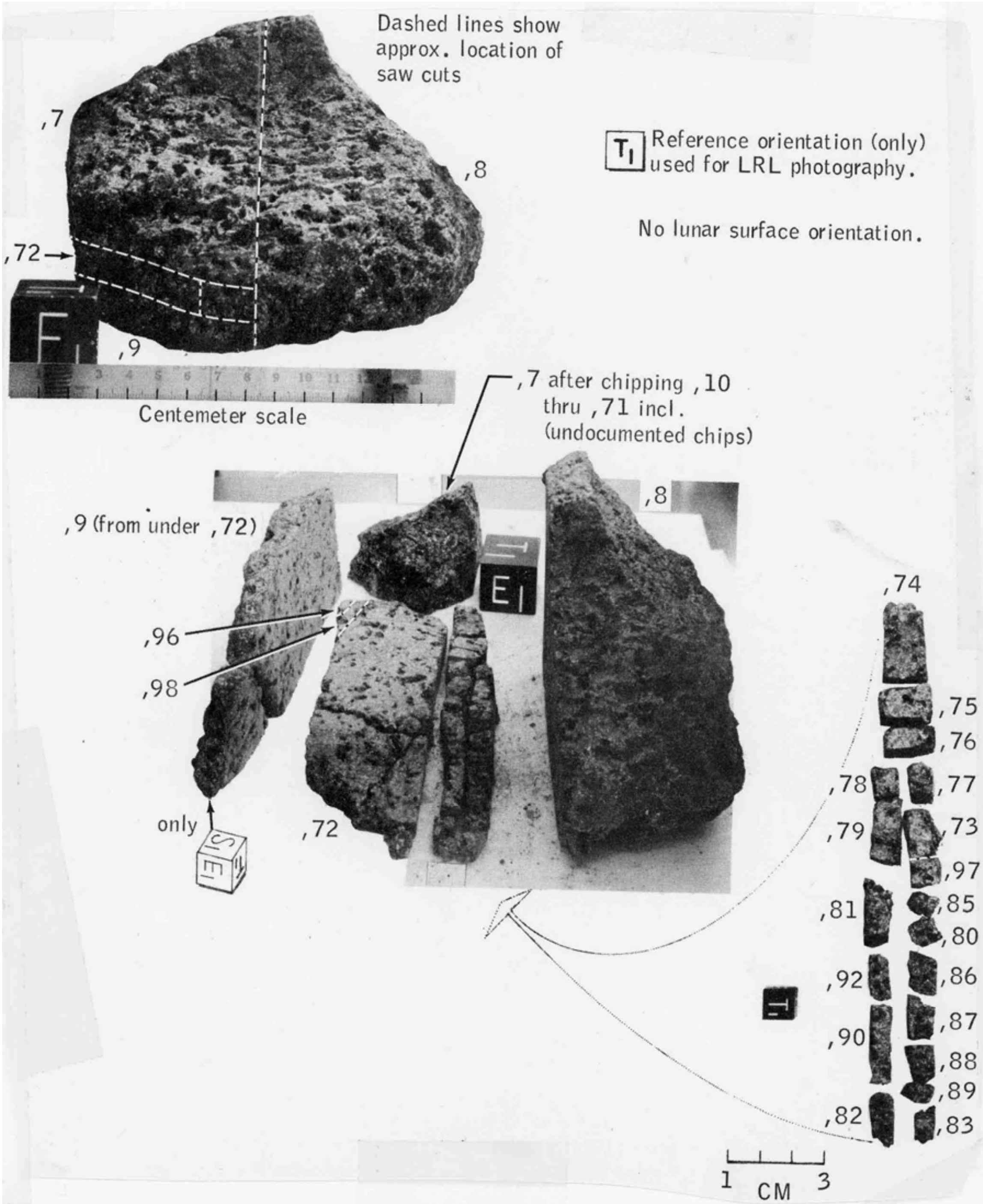

Figure 5: Diagram of the major divisions of 70017.