15455 FINE-GRAINED IMPACT MELT, WITH PRISTINE CLASTS 937.2

INTRODUCTION: 15455 is a very fine-grained impact melt of Mg-rich low-K Fra Mauro composition. It contains clasts of metamorphic and plutonic pristine igneous rocks, of which the dominant one is an anorthositic norite (Fig. 1), giving it its original name of "Black and White breccia." Clasts of surficial origin are absent. 15455 is very similar to 15445 which was collected nearby and both rocks have been interpreted to be fragments of melt rock produced in the Imbrium event (Ryder and Bower, 1977). 15455 was originally studied in a consortium led by L. Silver.

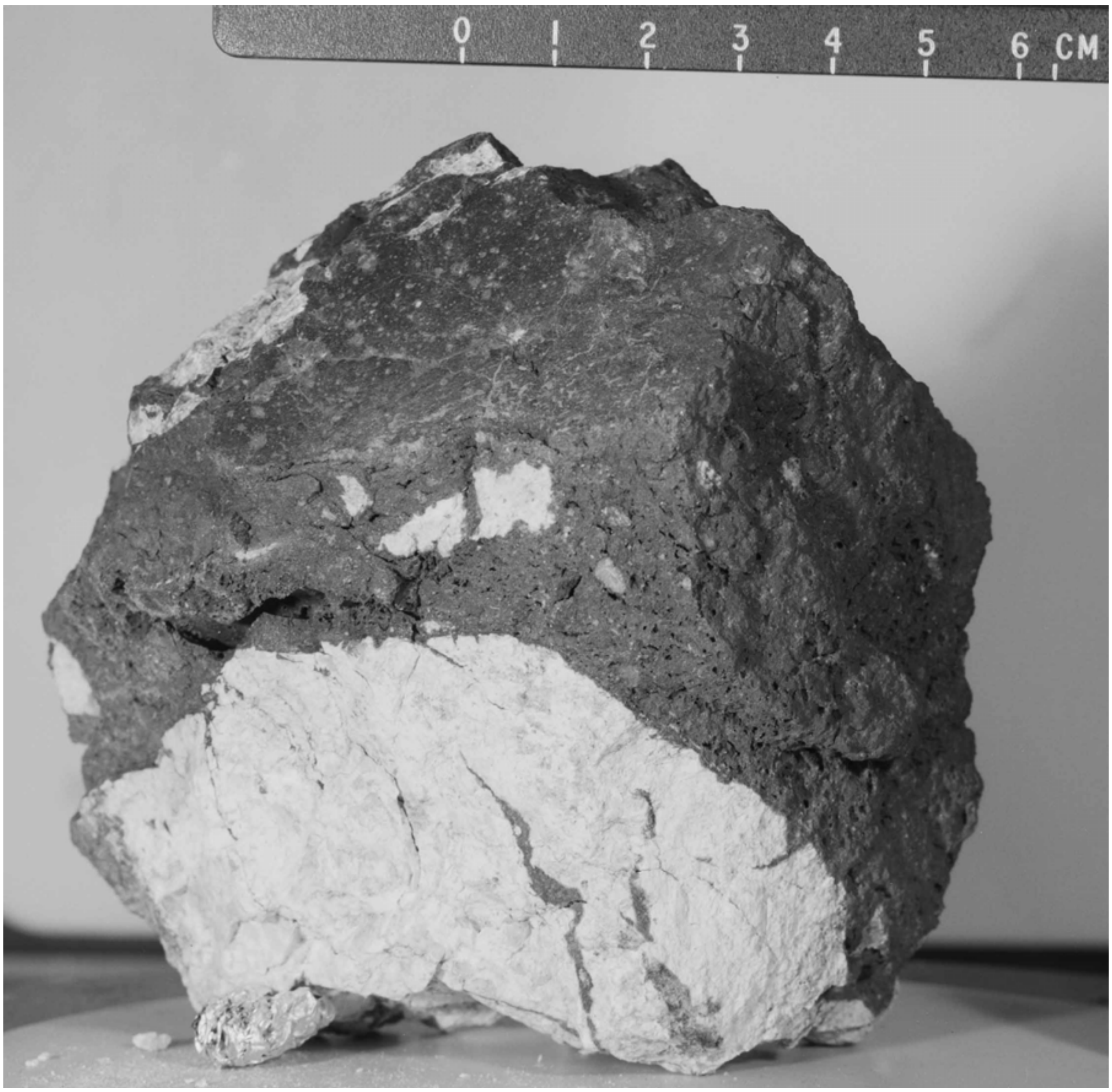

Figure 1. Macroscopic view of 15455, pre-cut but showing the future saw cut. Dashed areas are locations of documented loose pieces. S-71-46527

15455 was found lying about 15 meters from 15445 on the rim of Spur Crater, and was the largest of numerous rock fragments in an area of about 100 square meters that are characterized by the presence of high-albedo clasts (Swann et al., 1972). Like 15445, the sample is tough, blocky, and angular, with many zap pits on "N," "S," and "W," and few on "T" and "B." Vugs occupy 5 to 10% of the black matrix and average about 2 mm diameter. Veins of black aphanitic matrix are an ubiquitous feature of the norite clast (Figs. 1, 2).

<u>PETROLOGY</u>: 15455 consists of one large white anorthositic norite clast and several smaller white clasts in a dark gray, coherent, fine-grained impact melt matrix (Figs. 1 and 2). Locally the matrix contains vesicles and mineral fragments are ubiquitous. Veins of black aphanitic melt are common in the clasts, and appear to have altered the clasts for up to about 0.2 mm. The lithic clasts, in so far as they have been examined, appear to be pristine igneous or metamorphic varieties. Simonds et al. (1975) tabulated 15455 as a "black and white" breccia like some Apollo 16 rocks, but 15455 does not have the mutually intrusive forms and dimict nature of the Apollo 16 black-and-white (now "dimict breccias;" Stoffler et al., 1980).

Figure 2. Chipping slab cut from 15455 showing lithologies and split numbering. S-71-60917

<u>MATRIX</u>: James (1977) noted that the black material appeared to be fragment-laden melt that intruded the white material, and contained abundant xenoliths and xenocrysts in

a very fine-grained igneous-textured groundmass (Fig. 3). Ryder and Bower (1977 and in Interdisciplinary Studies by the Imbrium Consortium, 1977) described the matrix as it occurs in a vein injected into a white clast--finer-grained than but otherwise similar to the 15445 matrix, including skeletal olivines. Most mineral fragments are olivines or plagioclases, with pink spinel, ilmenite, Fe-metal, troilite, and other minor phases. Pyroxene is virtually absent. Olivine and plagioclase compositions (Fig. 4) (Ryder and Bower, 1977; Reid et al., 1977) are similar to those in 15445. Fe-metal grains in the matrix have 5-9% Ni (Hewins and Goldstein, 1975; Ryder and Bower, 1977) and Co abundances in the meteoritic range. Heuer et al. (1972) and Christie et al. (1973) using HVEM techniques, found no glass in the matrix, which they described as a dark, non-porous, annealed microbreccia. They did find that many of the larger fragments (>10 microns) in the matrix have internal deformation. Takeda and Ishii (1975) mention a thin section (,28) study but report no data. James (1977) noted that some xenocrysts are rounded and spherulitic devitrified maskelynite, with a history of shock more intense than the main anorthositic norite clast.

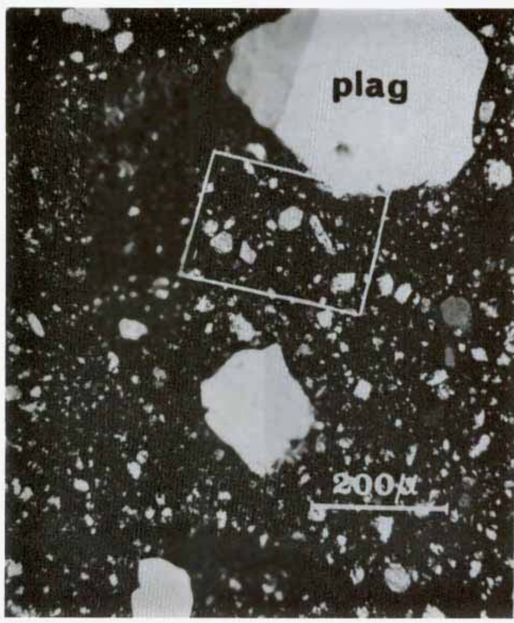

Fig. 3a

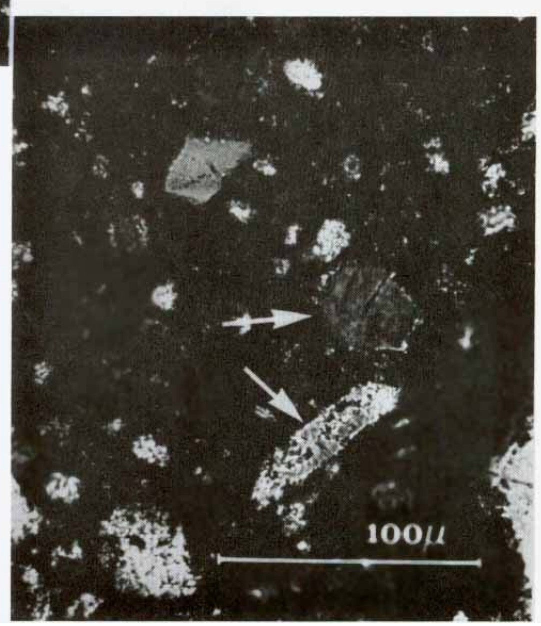

Fig. 3b

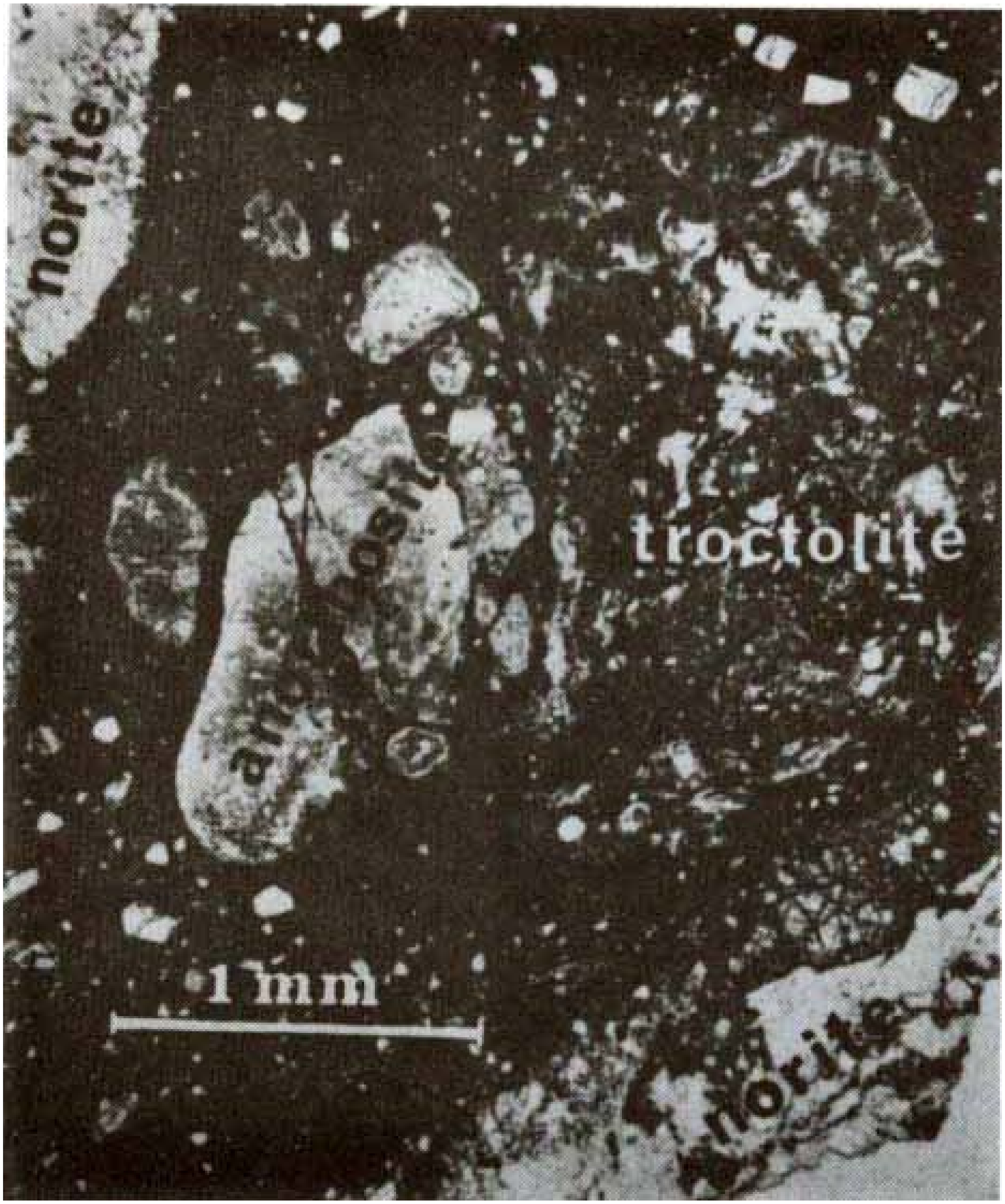

Fig. 3c

Figure 3. Photomicrographs of 15455.
a) general matrix of 15455,28, showing clasts and fine melt groundmass.
Rectangled area is Fig. 3b. Crossed polarizers,
b) euhedral olivines (arrowed) in 15455,28 melt groundmass.
Crossed polarizers,
c) fine-grained vein-area of melt groundmass of 15455,28 with
included small clasts. The main anorthositic norite clast
which the vein splits is designated "norite." Transmitted light.

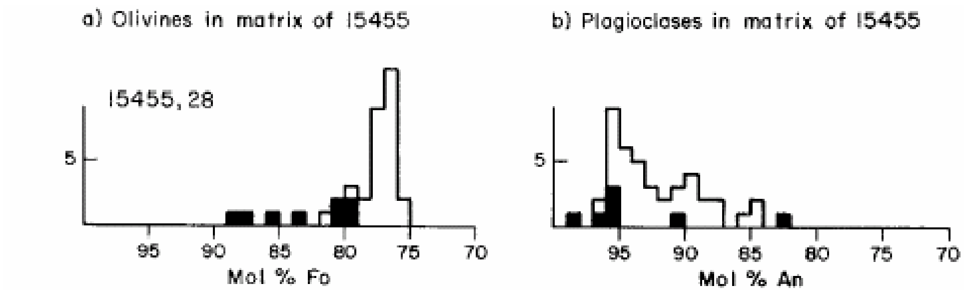

Figure 4. Compositions of minerals in matrix of 15455.
Shaded are clastic grains larger than about 50 microns; unshaped are grains smaller than about 50 microns and are mainly melt grains (Ryder and Bower, 1977).

LITHIC CLASTS: Several lithic clasts occur in 15455. They appear to be pristine plutonic igneous rocks, but they have not been studied except for the large anorthositic norite, and a troctolite.

1) Anorthositic norite: The large norite clast (about 200 g) contains white plagioclase and pale green orthopyroxene. It was described by Ryder and Bower (1977). It had been found to be free of meteoritic contamination by Ganapathy et al. (1973). It consists of about 70% plagioclase and 30% orthopyroxene (Fig. 5). It is cataclasized and friable (see Phinney et al., 1977; Reid et al., 1977) but retains some originally coarse-grained zones, and areas of relict igneous texture. Heuer et al. (1972) and Christie et al. (1973) found it to be porous with a narrow zone of low porosity near the contact. It is bonded with glass of anorthositic composition, and shows no sign of recrystallization.

The plagioclase and orthopyroxene compositions are restricted (Ryder and Bower, 1977; Reid et al., 1977; Warren and Wasson, 1980) (Fig. 6) and similar to those in the 15445 norite- $En_{80-83}Wo_{1-3}$; An_{91-95}. Unlike the 15445 norite, the anorthositic norite of 15455 contains a variety of accessory phases—augitic diopside, silica, armalcolite, chromite, ilmenite, phosphate, zircon, baddelyite, Fe-metal, and troilite (Ryder and Bower, 1977), with many occurring together interstitially and probably representing trapped liquid. Fe-metal in the norite (referred to as the anorthositic facies of 15455) analyzed by Hewins and Goldstein (1975) was found to contain up to 10% Co. They believed that a correlation between Ni and Co in the metal was suggestive of an igneous fractionation trend.

Blanchard and McKay (1980) made mineral separate analyses (see CHEMISTRY section). Both Takeda and Ishii (1975) and Mori et al. (1982) reported studying the norite but provided no data.

2) Troctolitic anorthosite: This small clast (about 3 g) was analyzed by Ganapathy et al. (1973) and found to be free of meteoritic contamination. It is an egg-shaped white clast (Fig. 2) containing pale yellow mafic grains. Warren and Wasson (1979) found it to be a troctolite, comminuted to less than 350 microns grain size, but with monomineralic zones suggesting an original grain size up to 2 mm (Fig. 5). In thin section ,224 it is about 6/9 plagioclase, 2/9 olivine, and 1/9 pyroxene, with very uniform

mineral compositions (Fig. 7) with pyroxenes and plagioclases similar to those in the norite. In ,169 it is about 75% plagioclase with the remainder mainly olivine, and with a feldspathic granulite texture (Ryder and Norman, 1979).

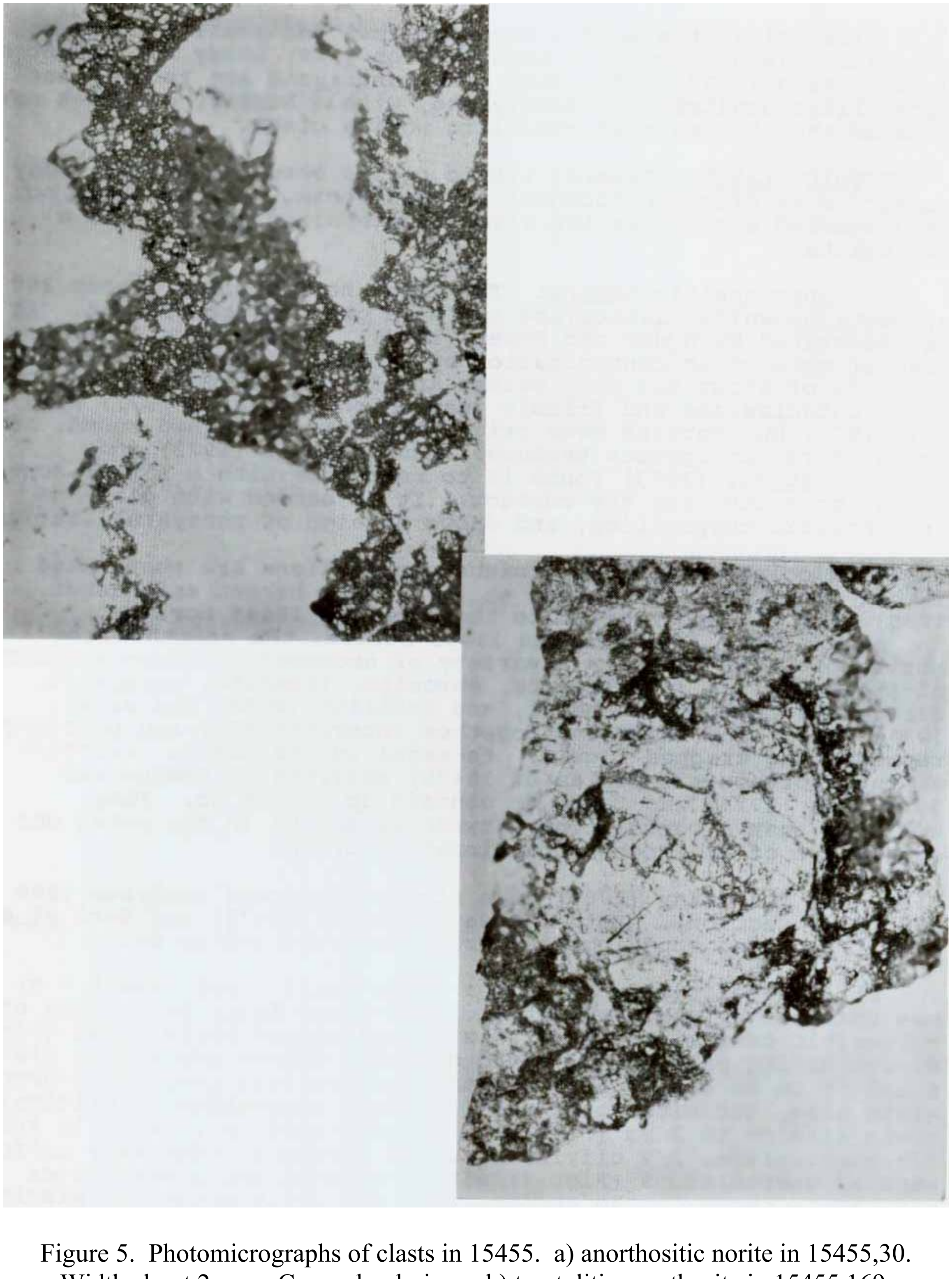

Figure 5. Photomicrographs of clasts in 15455. a) anorthositic norite in 15455,30. Width about 2 mm. Crossed polarizers, b) troctolitic anorthosite in 15455,169. Width about 2 mm. Crossed polarizers.

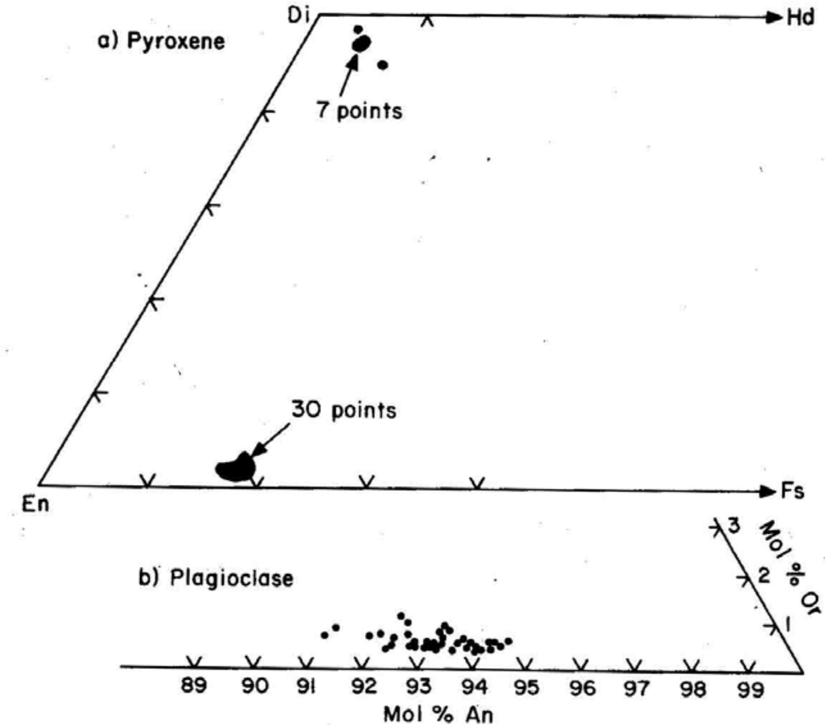

Figure 6. Compositions of minerals in anorthositic norite in 15455 (Ryder and Bower, 1977).

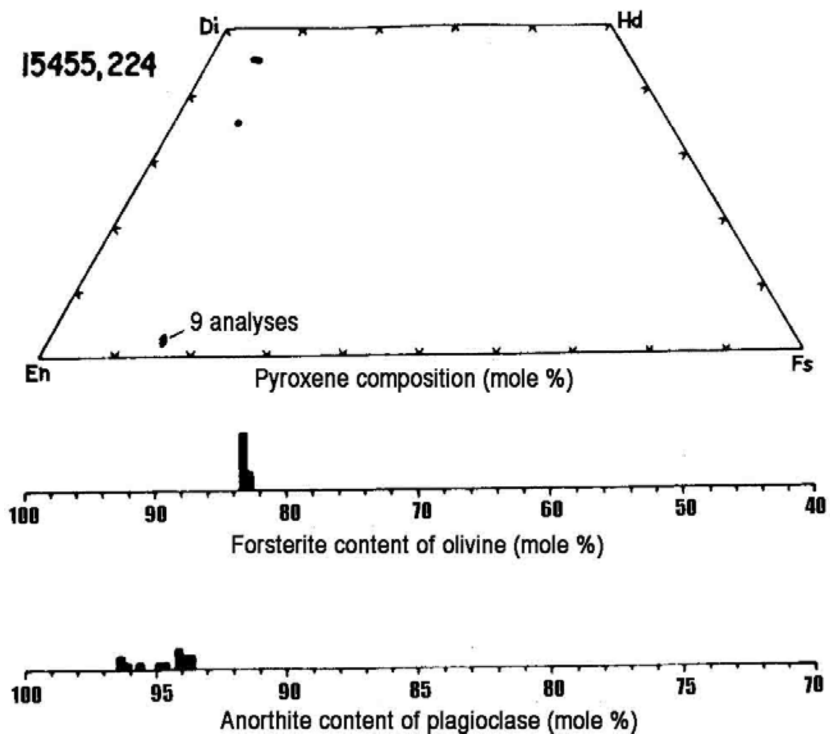

Figure 7. Compositions of minerals in troctolitic anorthosite in 15455. (Warren and Wasson, 1979).

3) Others: Most lithic clasts have not been separated and studied. A few in the matrix vein include anorthosite and troctolite (Ryder and Bower, 1977).

CHEMISTRY: Analyses for matrix, norite, and troctolitic anorthosite have been reported (Tables 1 - 4, Fig. 8).

MATRIX: Analyses are presented in Tables 1 and 2 and Figure 8. Those by Keith et al. (1972) and O'Kelley et al. (1972a, b, c) are gamma-ray measurements of the whole rock, though O'Kelley et al. stated that their analysis emphasizes the dark portion, i.e., matrix. The 15455 matrix is of low-K Fra Mauro composition (e.g., Taylor, 1973), similar to 15445.

Ganapathy et al. (1973) analyzed both vesicular and dense matrix, finding no real difference. Both contain siderophiles of meteoritic origin, which were assigned by Hertogen et al. (1977) to Group 1L, the same as 15445, and correlated with Imbrium. They match other KREEP-rich samples in pattern and absolute abundance for Ir, Re, Au, Ag, Zn, and Bi. Silver (1973) noted that U and Th were lower than other, regolith breccias at the Apollo 15 site and that 15455 was a rare type.

Modzeleski et al. (1972) reported analyses of carbon derived from CO, CO_2, and CH_4 as well as their total C abundance. Reed and Jovanovic (1972) and Jovanovic and Reed (1977) reported residue and leach analyses for Cl, Br, and I. They found that the nonleachable Cl was low. Moore et al. (1973) reported 39 ppm C for part of split ,63 which is a mixed norite and matrix sample, hence it is not known of what the analysis actually was.

LITHIC CLASTS:

1) Anorthositic norite: Several partial analyses for the norite phase have been reported (Table 3, Fig. 8). Those of Ganapathy et al. (1973) ("leucogabbro") and Warren and Wasson (1980) provided siderophile data demonstrating its lack of meteoritic contamination. Taylor et al. (1972, 1973) and Taylor (1973) analyzed the norite, but the CIPW norm has 20% olivine and only 7% pyroxene, and the low REE abundances and the REE pattern are those normally associated with plagioclase alone. The analyzed material was handpicked separates and may be unrepresentative of the norite as a whole (S.R. Taylor, pers. comm.). However, it is not quite as aluminous as that of Warren and Wasson (1980), which is slightly silica saturated. Bulk norite rare earth analyses are consistent with each other (Fig. 8) except for the S.R. Taylor analyses. They are high fractionated and have a positive Eu anomaly. They are similar to the 15445 norite abundances and pattern. Blanchard and McKay (1980) made analyses of mineral separates as well as bulk rock, and found it clear that the minerals had been in equilibrium with a highly evolved liquid with a distinct negative Eu anomaly. Silver (1976) noted the low Th/U ratio which is a result of plagioclase concentration.

TABLE 15455-1. Analyses of matrix of 15455

		,14	,183	,183	,38	,3	,0	,0	,183	,183	,66
Wt %	SiO2	• 47.3									
	TiO2	1.35									
	Al2O3	17.1									
	FeO	8.79									
	MgO	13.3									
	CaO	10.6								9.4	
	Na2O	0.58									
	K2O	0.17	0.143				0.108	0.127		0.132	
	P2O5					0.13					
(ppm)	Sc	13									
	V	39									
	Cr	1800									
	Mn										
	Co	22									
	Ni	184									
	Rb	2.7	2.91	2.7	2.2						
	Sr	141	161								
	Y	93									
	Zr	480	297								
	Nb	33									
	Hf	9.8									
	Ba	370	238								
	Th	5.31							2.855		
	U	1.37		0.715	0.875	0.14	0.53	0.53	0.770		
	Pb	3.0					2.0	2.0	1.857		
	La	32									
	Ce	81	62.0								
	Pr	11.5									
	Nd	47	38.6								
	Sm	12.8	10.6								
	Eu	1.82	1.91								
	Gd	15.5	12.6								
	Tb	2.41									
	Dy	16	13.4								
	Ho	3.76									
	Er	10.7	7.74								
	Tm	1.6									
	Yb	9.8	6.85								
	Lu	1.5	1.08								
	Li		13.6								
	Be										
	B										
	C										4.2
	N										
	S										
	F										
	Cl										
	Br			0.040	0.035						
	Cu	3.3									
	Zn			2.2	3.5						
(ppb)	I										
	At										
	Ga	3300									
	Ge			456	385						
	As										
	Se			89	92						
	Mo										
	Tc										
	Ru										
	Rh										
	Pd										
	Ag			1.6	1.6						
	Cd			2.5	2.3						
	In			0.35	0.34						
	Sn	220									
	Sb			1.5	1.9						
	Te			5.1	5.4	171					
	Cs	160		122	114						
	Ta										
	W										
	Re			0.41	0.63						
	Os										
	Ir			4.8	7.0						
	Pt										
	Au			4.6	5.8						
	Hg										
	Tl			0.41	0.32						
	Bi			0.21	0.17						
		(1)	(2)	(3)	(4)	(4)	(5)	(6)	(7)	(8)	(9)

References for Table 15455-1

Reference and methods:

(1) Taylor et al. (1972, 1973); Taylor (1973); spark source-mass spec/emission spec/microprobe
(2) Philpotts, unpublished; ID/MS
(3) Ganapathy et al. (1973); RNAA
(4) Reed and Jovanovic (1972), Jovanovic and Reed (1977); INAA, colorimetry
(5) Kelley et al. (1972a, b); gamma ray spectrometry
(6) Keith et al. (1972); gamma ray spectrometry
(7) Silver (1973); ID/MS
(8) Alexander and Kahl (1974); from argon isotopes from irradiation
(9) Modzeleski et al. (1972); vacuum pyrolysis/mass spec

TABLE 15455-2. Microprobe defocussed beam analyses of matrix
(Ryder and Bower, ICR 2)

Wt %	SiO2	43.6
	TiO2	1.34
	Al2O3	20.5
	FeO	8.1
	MgO	14.0
	CaO	10.8
	Na2O	0.58
	K2O	0.14
ppm	Cr	1200
	Mn	600

Modzeleski et al. (1972) reported analyses of carbon derived from CO, CO_2, and CH_4 as well as their total C abundance. Surprisingly the norite contains more total C (9.0 v. 4.2 ppm) than the matrix. Reed and Jovanovic (1972) and Jovanovic and Reed (1977) provided analyses of residue and leach for Cl, Br, and I.

2) Troctolitic anorthosite: Ganapathy et al. (1973) found a clast of "anorthositic breccia" to be free of meteoritic contamination. A follow-up study by Warren and Wasson (1979) confirmed the pristinity of the clast (Table 4) and found it to be a troctolitic anorthosite. The norm has 58% feldspar, 29% olivine, and 13% orthopyroxene, and the rare earths are modestly fractionated in comparison with KREEP.

STABLE ISOTOPES: Epstein and Taylor (1972) made analyses for oxygen isotopes on both a matrix and norite sample, and a silicon isotopic analysis on the matrix (Table 5), without specific discussion. The isotopic values are similar to other lunar materials analyzed.

RADIOGENIC ISOTOPES/GEOCHRONOLOGY: Silver (1973) reported Pb isotopic compositions and Pb, U, and Th abundances for both matrix and anorthositic norite splits (Table 6). The Pb isotopic ratios differ from soils and other Apollo 15 breccias, and surprisingly show younger model ages distinct from any other Apollo 15 breccia.

TABLE 15455-3. Analyses of anorthositic norite

		,20	,183	,9015	,70A	,3	,70A	,70A	,228-1	,228-2	,65
Wt %	SiO2	44.4		47.7							
	TiO2	<0.07		0.1							
	Al2O3	26.2		27.0							
	FeO	4.2		2.8							
	MgO	10.9		6-9							
	CaO	14.3		14.8			10.2				
	Na2O	0.36		0.44							
	K2O	<0.06	0.058	0.08			0.053				
	P2O5					0.051					
(ppm)	Sc			5.33							
	V	16.0									
	Cr	440		1180							
	Mn			376							
	Co	10.0		27.2							
	Ni	12.0		21							
	Rb		1.09		1.1				1.133	1.065	
	Sr	270	124						137.9		
	Y	4.8									
	Zr	11.0		70							
	Nb	0.95									
	Hf	0.17		0.67							
	Ba	42.0	58.7	125							
	Th	0.23		0.59	0.195			0.665			
	U	0.05		0.18		0.073		0.258			
	Pb	1.00						0.592			
	La	3.0		4.8							
	Ce	6.7	10.5	11.8							
	Pr	0.95									
	Nd	3.73	6.66	7.4					7.79	5.379	
	Sm	0.88	1.86	1.74					2.13	1.502	
	Eu	1.67	1.03	1.38							
	Gd	0.95	2.21								
	Tb	0.14		0.35							
	Dy	0.84	2.59								
	Ho	0.17									
	Er	0.46	1.64								
	Tm	0.06									
	Yb	0.36	1.65	1.22							
	Lu	0.06	0.262	0.17							
	Li		6.08			8.4					
	Be										
	B										
	C										9.0
	N										
	S										
	F										
	Cl										
	Br				0.035						
	Zn			1.0	1.85						
(ppb)	I										
	At										
	Ga	2600									
	Ge			56	9.4						
	As										
	Se				8.3						
	Mo										
	Tc										
	Ru										
	Rh										
	Pd										
	Ag				1.7						
	Cd				1.0						
	In				0.05						
	Sn	670									
	Sb				0.079						
	Te				2.6	124					
	Cs				126						
	Ta			140							
	W										
	Re			6.3	0.0023						
	Os										
	Ir			0.020	<0.002						
	Pt										
	Au			0.023	0.009						
	Hg										
	Tl				0.054						
	Bi				0.14						
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8?)	(8)	(9)

References for Table 15455-3

References and methods:

(1) Taylor et al. (1972, 1973), Taylor (1973); Spark source-mass spec/emission spec/microprobe.
(2) Philpotts J.A. (pers. comm.)
(3) Warren and Wasson (1980); INAA, RNAA, microprobe fused bead.
(4) Ganapathy et al. (1973); RNAA.
(5) Reed and Jovanovic (1972), Jovanovic and Reed (1977); INAA, colorimetry.
(6) Alexander and Kahl (1974); from Ar isotopes from irradiation.
(7) Silver (1973); isotope dilution/mass spec.
(8) Nyquist et al. (1979); isotope dilution/mass spec.
(9) Modzeleski et al. (1972); vacuum pyrolysis/mass spec.

Notes:

Taylor et al. (1972) reported Zr as 42 ppm and Sr as 218 ppm, both in error. Zr of 42 ppm would give a very high Zr/H_f ratio. Sr of 218 ppm is not compatible with the reported value of Sr/Eu. Taylor (1973) erroneously reported a value of Ti = 0.26%, and omitted "less than" symbols from TiO_2 and K_2O. The abundances in Taylor et al. (1972) were generally slightly revised in the later publications.

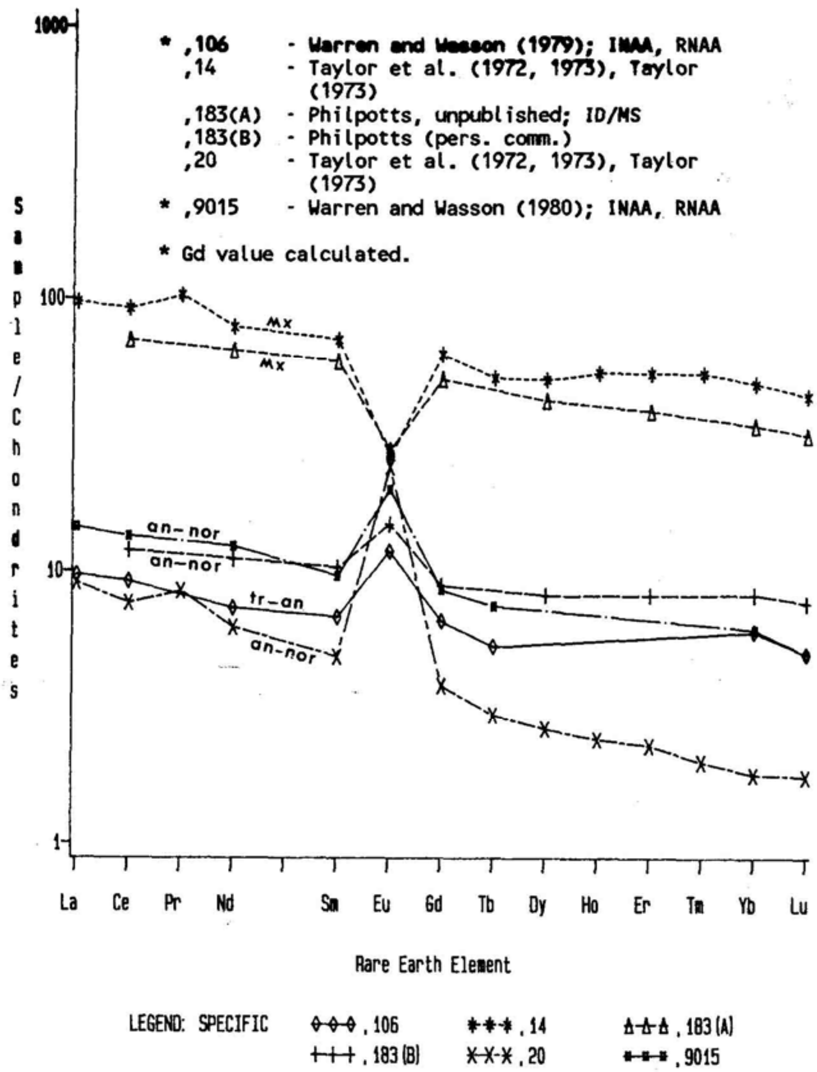

Figure 8. Rare earths in matrix and clasts in 15455.

TABLE 15455-4. Analyses of troctolitic anorthosite

		,106	,179
Wt %	SiO_2	44.3	
	TiO_2	0.08	
	Al_2O_3	21.9	
	FeO	5.8	
	MgO	16.1	
	CaO	11.6	
	Na_2O	0.23	
	K_2O	0.044	
	P_2O_5		
(ppm)	Sc	4.1	
	V		
	Cr	970	
	Mn	560	
	Co	25	
	Ni	26	
	Rb		0.54
	Sr		
	Y		
	Zr		
	Nb		
	Hf	0.86	
	Ba	77	
	Th	0.58	
	U	0.18	0.170
	Pb		
	La	3.2	
	Ce	8.1	
	Pr		
	Nd	4.4	
	Sm	1.23	
	Eu	0.82	
	Gd		
	Tb	0.25	
	Dy		
	Ho		
	Er		
	Tm		
	Yb	1.2	
	Lu	0.17	
	Li		
	Be		
	B		
	C		
	N		
	S		
	F		
	Cl		
	Br		0.030
	Cu		
	Zn	1.33	1.7
(ppb)	I		
	At		
	Ga	3100	
	Ge	14	11
	As		
	Se		9.6
	Mo		
	Tc		
	Ru		
	Rh		
	Pd		
	Ag		0.79
	Cd	2.9	0.91
	In	0.50	0.06
	Sn		
	Sb		0.22
	Te		7.5
	Cs		54
	Ta	140	
	W		
	Re	<0.010	0.0058
	Os		
	Ir	0.024	0.024
	Pt		
	Au	1.90	0.042
	Hg		
	Tl		0.058
	Bi		0.140
		(1)	(2)

References and methods:

(1) Warren and Wasson (1979); INAA, RNAA, microprobe fused beads.
(2) Ganapathy et al. (1973; RNAA.

Alexander and Kahl (1974) obtained ^{40}Ar-^{39}Ar data from both a matrix and an anorthositic norite split (Fig. 9a). No plateaus were obtained for either. The norite suffered greater argon loss. By 700° C, the matrix released 43%, and the norite 63%, of its argon and has apparent younger ages for the 400° to 1100° C release. From the releases above 400° C, a minimum age of 3.82 b.y. is suggested for the norite, and a best estimate of the last major event affecting the matrix is 3.92 ± 0.04 b.y. A similar intermediate release age (~3.9 b.y.) for the norite was obtained by Shih et al (1993) (Fig. 9b). Bernstein (1983) in a preliminary laser-probe ^{40}Ar-^{39}Ar study of the matrix obtained an imprecise age of 3.90 ± 0.25 b.y., and suggested that there had been incomplete degassing of plagioclase clasts during matrix formation. Nyquist et al. (1979) obtained Rb-Sr isotopic data for a norite sample (,228) (Table 7). An internal isochron yielded an age of 4.52 ± 0.10 b.y. ($\lambda = 1.39 \times 10^{-11}$ yr^{-1}) and an initial $^{87}Sr/^{86}Sr$ of 0.69903 ± 7. Further analyses (Nyquist, unpublished) modified this slightly to 4.58 ± 0.12 b.y. with initial $^{87}Sr/^{86}Sr$ of 0.69900 ± 6 (Fig. 10). The initial ratio is equivalent to LUNI as derived from Apollo 16 anorthosites, and would not be expected if the pyroxene data were artifacts, hence the isochron provides direct evidence for the early formation of the rock. A Sm-Nd analysis (Table 7) of bulk norite is consistent with that age, yielding calculated initial $^{143}Nd/^{144}Nd$ of 0.050596 ± 11 (at 4.52 b.y.) or 0.50591 ± 5 (at 4.56 b.y.), in agreement with eucrites. The model age (T_{ICE}) is 4.42 ± 0.34 b.y., and the ϵ value at 4.52 b.y. is +0.13 ± 1.1. Further Sm-Nd data (Nyquist, 1982 unpublished; Nyquist et al., 1981) for three whole rock splits show two with ϵ_{nd} of 0 at 4.4 b.y. but the other with ϵ_{nd} of +1.5 at 4.4 b.y. (Fig. 11). These three splits and a pyroxene datum give a Sm-Nd isochron age of 4.56 ± 0.26 b.y. with initial $^{143}Nd/^{144}Nd$ of 0.50596 ± 32, but a plagioclase datum falls well off this line (Fig. 12).

TABLE 15455-5. Stable isotopes in 15455
(Epstein and Taylor, 1973)

Split	δO^{18}	δSi^{30}
white (norite)	5.83	--
dark (matrix)	5.90	-0.26

TABLE 15455-6. Pb isotopic ratios of 15455
(Silver, 1973)

SPLIT	TYPE	$\frac{Pb^{206}}{Pb^{204}}$	$\frac{Pb^{207}}{Pb^{204}}$	Pb ppm
,70A	An-norite	98.83	54.03	0.592
,183	matrix	185.26	103.98	1.857

RARE GAS AND EXPOSURE: Alexander and Kahl (1974) derived a ^{38}Ar exposure age, from combined matrix and norite data, of 205 ± 21 m.y., an age representing a lower limit. Bernstein reported a ^{38}Ar exposure age of 190 m.y. for a matrix sample. Lightner and Marti (1974) reported Xe isotopic data for a matrix sample, without discussion. Keith et al. (1972) reported cosmogenic nuclide disintegration count data (^{26}Al, ^{22}Na, ^{54}Mn, ^{56}Co, and ^{46}Sc) for the bulk rock. Yokoyama et al. (1974) could not decide whether the sample was saturated in ^{26}Al or not.

PHYSICAL PROPERTIES: Cisowski et al. (1982) measured magnetic remanence in a matrix sample of 15455, finding a very low normalized intensity (NRM(200)/IRM_s(200) of about 4 x 10^{-3}. Housley et al. (1976) tabulated a matrix sample as having a very weak FMR intensity.

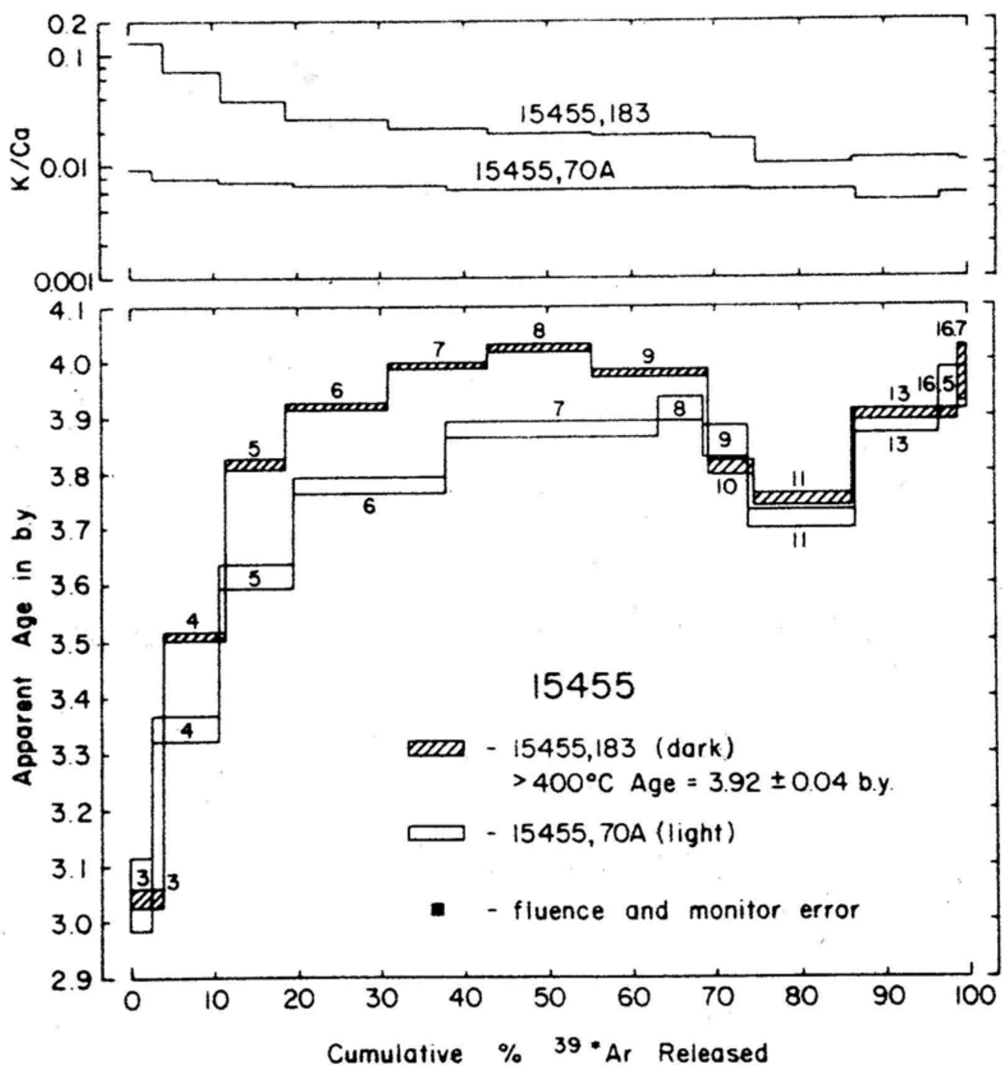

Fig. 9a

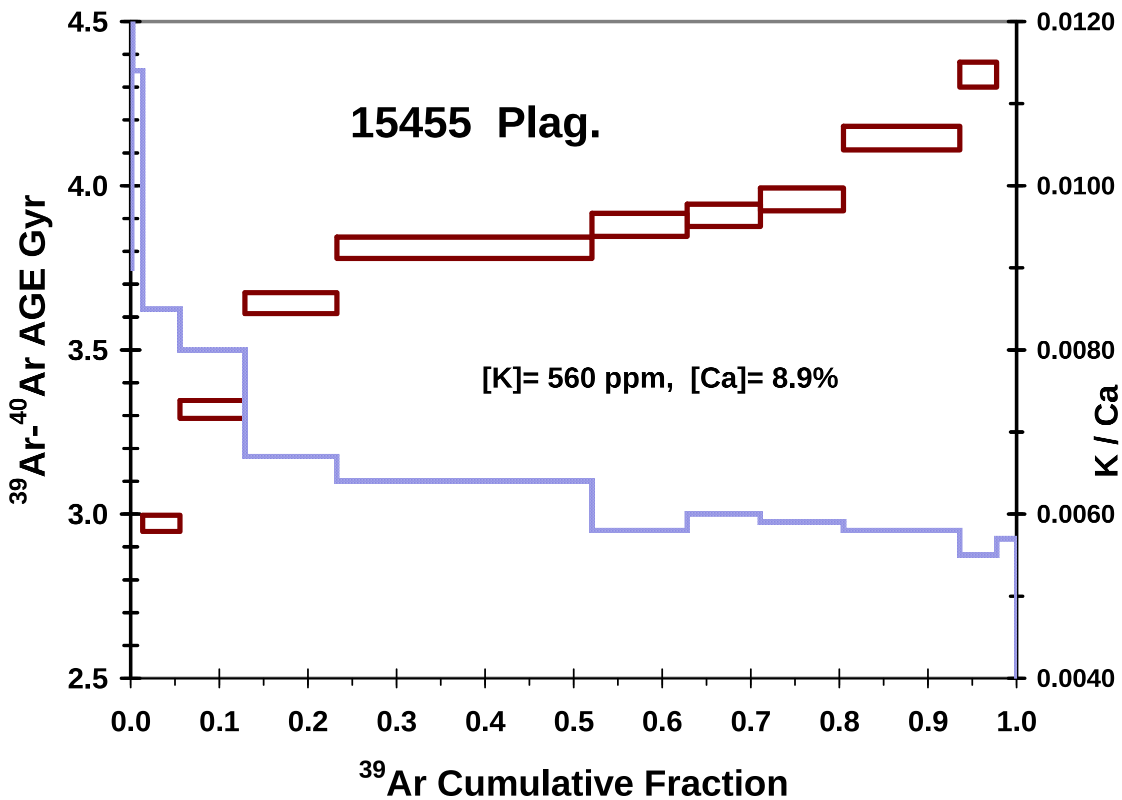

Fig. 9b

Figure 9. a) K/Ca and Ar release for 15455 samples.
,183 is matrix; ,70A is anorthositic norite (Alexander and Kahl, 1974);
b) K/Ca and Ar release for 15455 (Shih et al, 1993).

TABLE 15455-7. Sr and Nd isotopic data for the norite
(Nyquist et al., 1979)

Sample	Wt (mg)	Rb (ppm)	Sr (ppm)	$^{87}Rb/^{86}Sr$ (a)	$^{87}Sr/^{86}Sr$ (b)	Sm (ppm)	Nd (ppm)	$^{147}Sm/^{144}Nd$ (a)	$^{143}Nd/^{144}Nd$ (b)
W. R. 1	46	1.133	137.9	0.0237±2	0.70062±7	2.13	7.79		
W. R. 2	46	1.065				1.502	5.379	0.1689±3	0.511024±53
Plag	5.5	1.299	167.2	0.0225±2	0.70047±4	-	-	-	-
PX	7.6	0.485	15.03	0.0934±8	0.70508±6	-	-	-	-

(a) Uncertainties are for last digit.

(b) Uncertainties are for last digit and are $2\sigma_m$. Sr normalized to $^{88}Sr/^{86}Sr$ = 8.37521;
Nd normalized to $^{148}Nd/^{144}Nd$ = 0.24308.

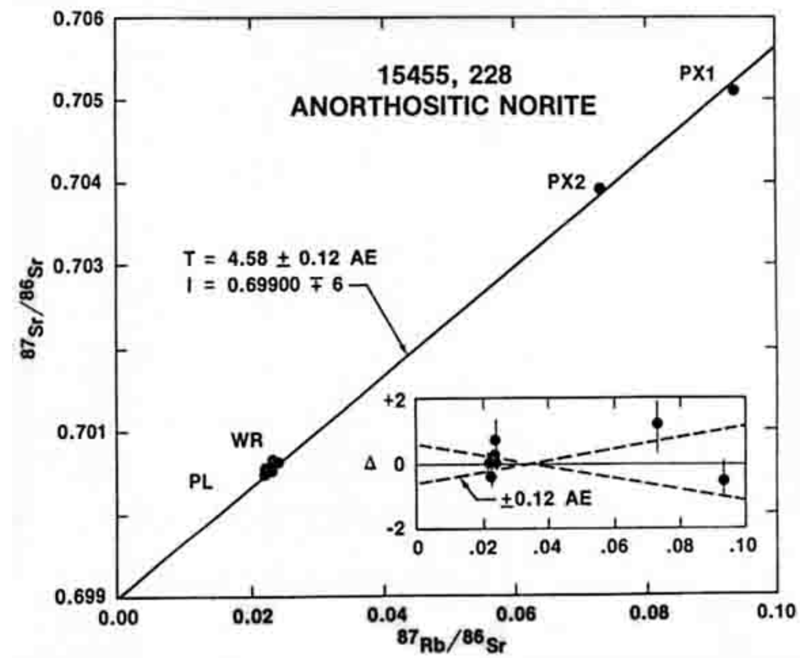

Figure 10. Rb-Sr isochron for 15455 anorthositic norite (Nyquist, pers. comm.).

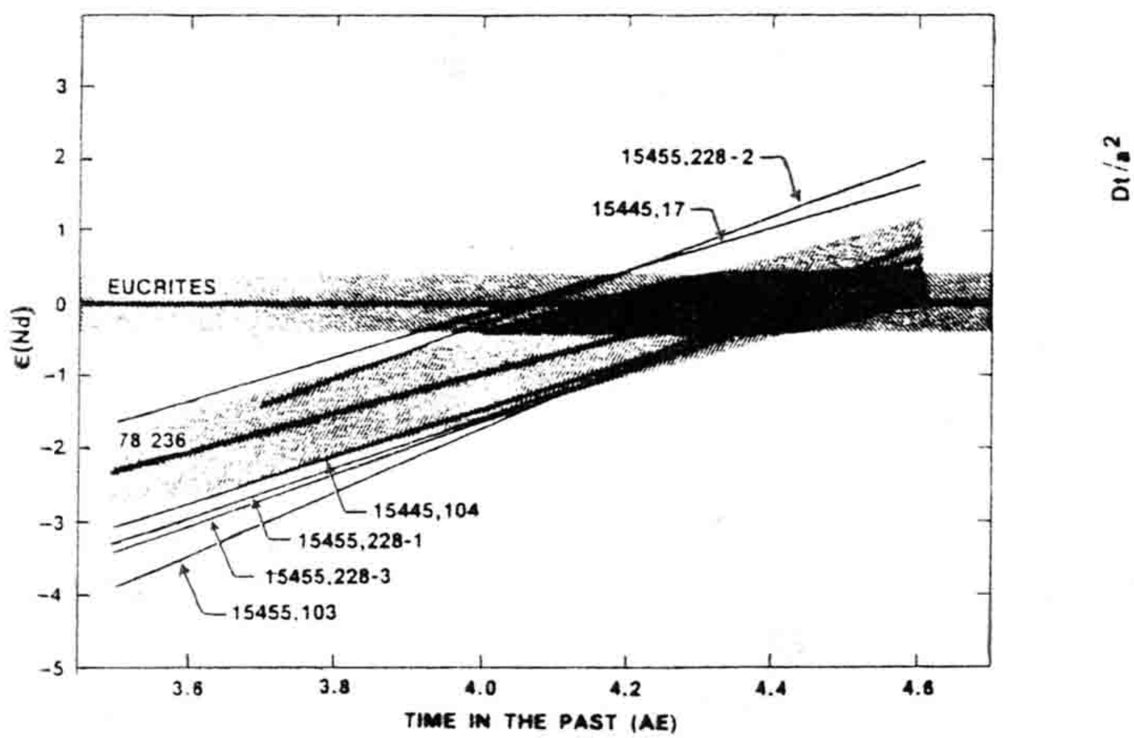

Figure 11. Nd evolution diagram for 15455 anorthositic norite samples, and 15445 and 78236 norite samples (Nyquist et al., 1981).

PROCESSING AND SUBDIVISIONS: 15455 was received as one large piece and 22 smaller pieces up to 3 g, including matrix and white clast material. Some of these fragments were locatable on the main piece (e.g., Fig. 1). Several whole fragments, mainly believed to be from the larger white clast, were allocated. Subsequently a slab (,38) was cut (Figs. 1, 2), exposing several white clasts. The sawing produced an intact end piece (,37) which is in remote storage. The other end piece is stored as several individual pieces (,39-,53) which have never been allocated. The slab itself was broken into a few pieces and the main part (,38 and ,70) allocated to the Silver Consortium for subdivision (Fig. 2).

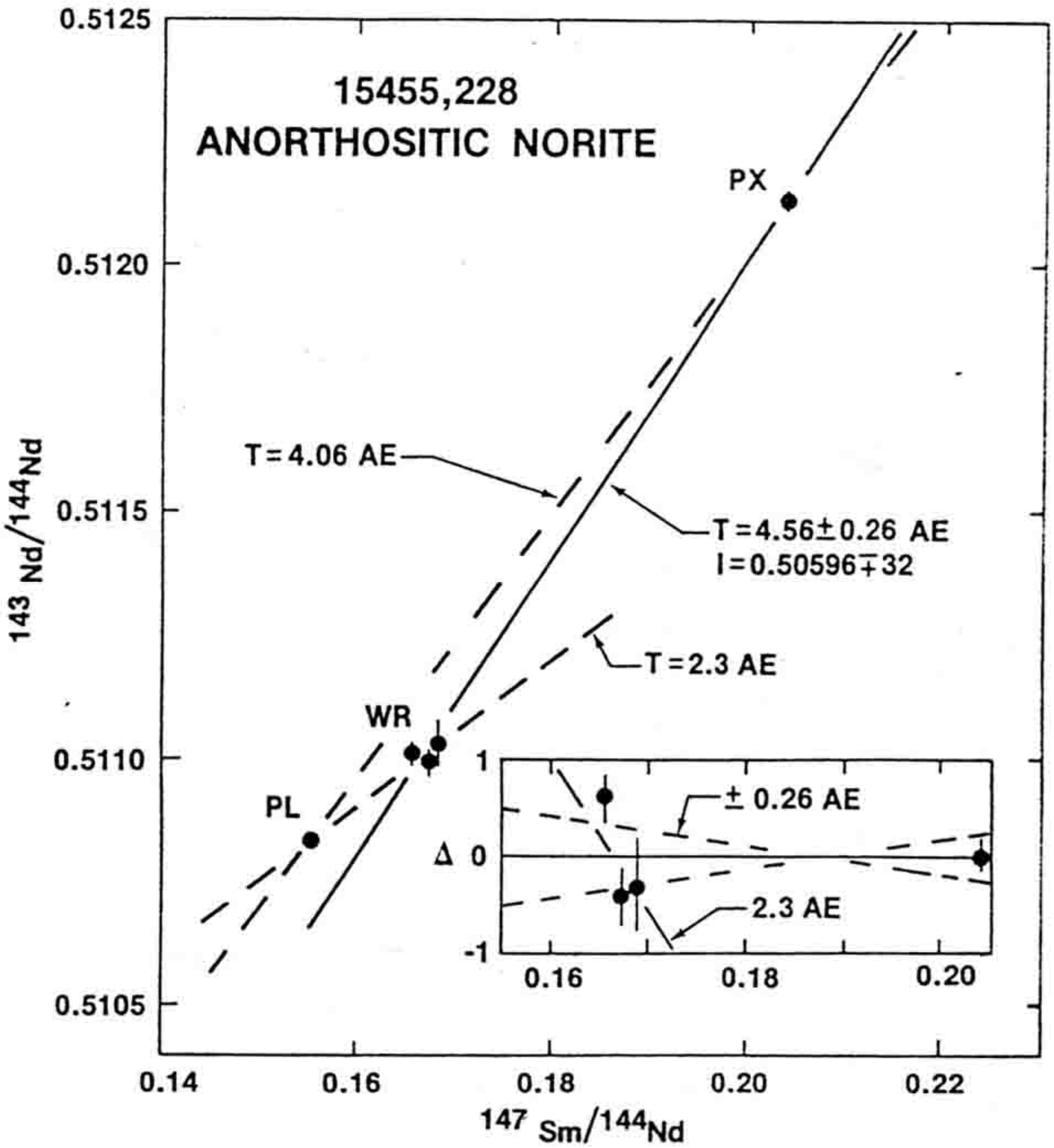

Figure 12. Sm-Nd "isochron" for 15455 anorthositic norite (Nyquist, Pers. comm.).