72559

Granoblastic Impactite
St. 2, 27.8 g

INTRODUCTION

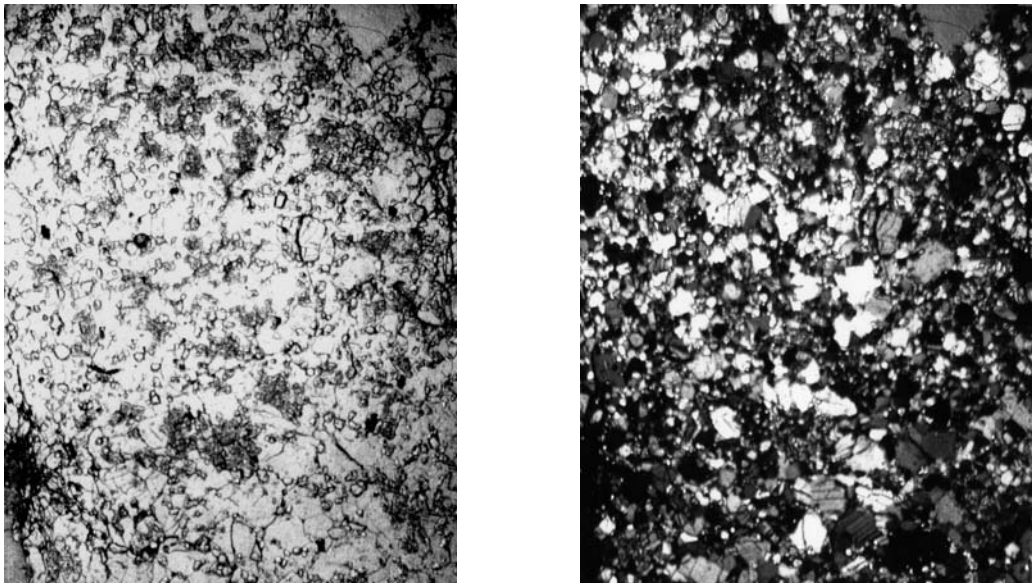
72559 is a subrounded, partly subangular tough block (Fig. 1) collected as part of the first rake sample at Station 2, near Boulder 2. Its petrography and chemistry show that it is a feldspathic impactite, unique among individual South Massif samples. According to LSIC Apollo 17 (1973) and Keil et al. (1974) 72559 is light olive gray (5Y 6/1) and 3.4 x 2.3 x 1.6 cm. It was singled out as distinct macroscopically among the rake samples, of which it is one of the largest as well as most obviously feldspathic. Keil et al (1974) identified it as a cataclastic anorthosite. Macroscopically it appeared to be virtually all plagioclase, but thin sections show about 75% feldspar. 72559 is coherent with a few non-penetrative fractures, has no vugs, and some zap pits (LSIC Apollo 17, 1973 states many; Keil et al., 1974, states few).

PETROGRAPHY

72559 is a granoblastic feldspathic impactite with a fine-grained groundmass (Fig. 2) and is a recrystallized anorthositic norite. It has a partly poikiloblastic texture and some apparent relict lithic clasts. Petrographic descriptions were given by Warner et al. (1977c, 1978c, 1978f), and Nehru et al. (1978); the latter is the more detailed. The texture and homogeneous mineral chemistry of 72559 is most consistent with an origin of brecciation of a source consisting only of related feldspathic igneous rocks followed by thermal metamorphism.

According to Nehru et al. (1978), 72559 contains (in volume %) plagioclase (74.5), olivine (14.4), orthopyroxene (10.2), and

Figure 1: Sample 72559 prior to chipping. Small scale divisions in millimeters. S-73-33433.



a **b**

Figure 2: Photomicrograph of 72559,10, showing typical texture. Field of view about 1 mm wide. a) plane transmitted light. b) crossed polarized light.

accessories (0.9); that include high-Ca pyroxene, Mg-Al-spinel, chromite, armalcolite, ilmenite, zircon, K-Feldspar, metal, and troilite. Larger grains of plagioclase and olivine are set in a fine-grained granoblastic groundmass of plagioclase, olivine, and orthopyroxene (Fig. 2). Orthopyroxene is partly poikiloblastic. Microprobe analyses are given in Fig. 3, with representative analyses in Table 1. The silicate minerals are very homogeneous (An_{98-96}; Fo_{81}; $En_{79-81}Wo_{3-4}$) but the opaque oxides show ranges. Two areas (each about 1 mm^2) are apparently lithic clasts; one is almost 100% plagioclase i.e. an anorthosite, with a granoblastic texture; the other is a troctolite. The mineral compositions of the lithic clasts are the same as in the matrix.

The textural evidence and mineralogical evidence suggest that a fairly homogeneous KREEP-free source was brecciated and thermally metamorphosed. The opaque oxides may represent

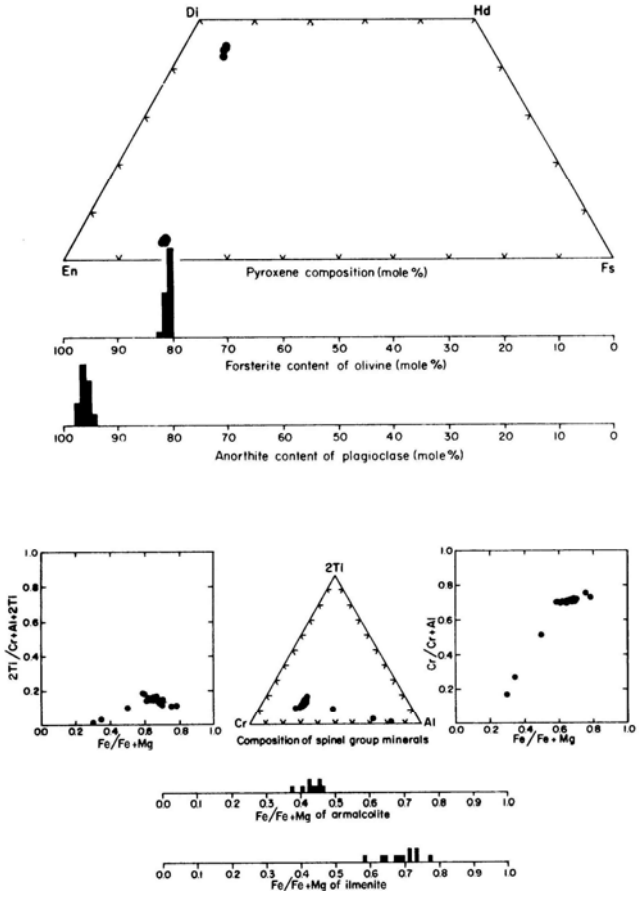


Figure 3: Microprobe analyses of mineral phases in 72559,10 (Warner et al., 1978f; Nehru et al., 1978).

Table 1: Representative analyses of silicates in 72559 (Nehru et al., 1978).1) large plagioclase. 2) matrix plagioclase. 3) large olivine. 4) matrix olivine. 5) matrix orthopyroxene. 6) matrix clinopyroxene.

	1	2	3	4	5	6
SiO_2	43.3	44.1	39.3	39.5	54.7	51.0
TiO_2	n.a.	n.a.	0.07	<0.05	0.78	1.86
Al_2O_3	35.2	35.1	<0.01	<0.01	1.29	2.63
Cr_2O_3	n.a.	n.a.	<0.05	0.05	0.45	0.67
FeO	0.07	0.24	17.8	17.3	10.7	5.0
MgO	0.05	0.06	41.8	41.9	29.2	16.5
CaO	19.8	19.4	0.08	0.13	1.87	21.2
Na_2O	0.32	0.44	n.a.	n.a.	n.a.	n.a.
K_2O	0.12	0.15	n.a.	n.a.	n.a.	n.a.
Total	98.9	99.5	99.1	98.9	99.0	98.9
An	96.5	95.2				
Ab	2.8	3.9				
Or	0.7	0.9				
Fo			80.7	81.2		
Fa			19.3	18.8		
En					80.0	47.8
Fs					16.4	8.1
Wo					3.7	44.1

trapped liquid in originally cumulate rocks, whereas most of the silicates represent cumulus phases. The homogeneity of the minerals could represent either original igneous plutonic homogeneity or metamorphic equilibration. The pyroxenes do not show exsolution, but the coexisting high-Ca and low-Ca phases suggest re-equilibration at 950-1000 degrees C. The range in composition of the oxides is preferred by Nehru et al (1978) to represent the original igneous variation rather than reaction, except for the Mg-Al spinels.

CHEMISTRY

Two analyses are reproduced in Table 2, and the rare earths are shown in Fig. 4 (with average LKFM from Boulder 2 at Station 2 for comparison). The two analyses are reasonably consistent, and show that the rock is a magnesian anorthositic troctolite, with considerable meteoritic contamination and lack of a KREEP component. The chemistry is fairly typical for a feldspathic granulitic impactite, with low rare earths and a positive Eu anomaly, quite distinct from the LKFM melt rocks. Warren and Wasson (1978) noted some discrepancies of their analysis (<250 mg) with that of Murali et al. (1977a) (605 mg) that they attributed mainly to non-representative sampling.

PROCESSING

In 1974 a few chips were removed from one end of 72559. Two small pieces (,1) were allocated and used for a thin section and for chemistry. In 1977 fragments constituting ,2 were allocated for chemistry and three further thin section. Four small chips constituting ,3 remain in storage, as well as the main mass ,0 (26.5 g).

Table 2: Chemical analyses of 72559.

Split	,5	,1
wt %		
SiO_2	42.4	45
TiO_2	0.2	<0.2
Al_2O_3	28.5	25.2
Cr_2O_3	.14	0.130
FeO	4.7	5.3
MnO	0.05	0.055
MgO	8.41	10
CaO	15.3	13.7
Na_2O	.35	0.30
K_2O	0.1	0.093
P_2O_5		
ppm		
Sc	6.5	5.5
V		20
Co	37.1	32
Ni	494	470
Rb		
Sr		
Y		
Zr		
Nb		
Hf	1.3	1.4
Ba	70	59
Th	0.77	0.3
U	0.23	
Cs		
Ta		0.41
Pb		
La	3.2	3.4
Ce	8.3	6.4
Pr		
Nd		
Sm	1.27	1.3
Eu	0.8	0.74
Gd		
Tb	0.3	0.2
Dy		2
Ho		
Er		
Tm		
Yb	1.58	1.5
Lu	0.23	0.23
Li		
Be		
B		
C		
N		
S		
F		
Cl		
Br		
Cu		
Zn	5.4	
ppb		
Au	26.7	5
Ir	13.6	16
I		
At		
Ga	3930	
Ge	119	
As		
Se		
Mo		
Tc		
Ru		
Rh		
Pd		
Ag		
Cd	27000	
In	2600	
Sn		
Sb		
Te		
W		
Re		
Os		
Pt		
Hg		
Tl		
Bi		
	(1)	(2)

References and methods:
(1) Warren and Wasson (1978); INAA, RNAA, except majors mainly microprobe fused bead
(2) Murali et al. (1977a);Nehru et al. (1978); INAA, except SiO2 from modal proportions

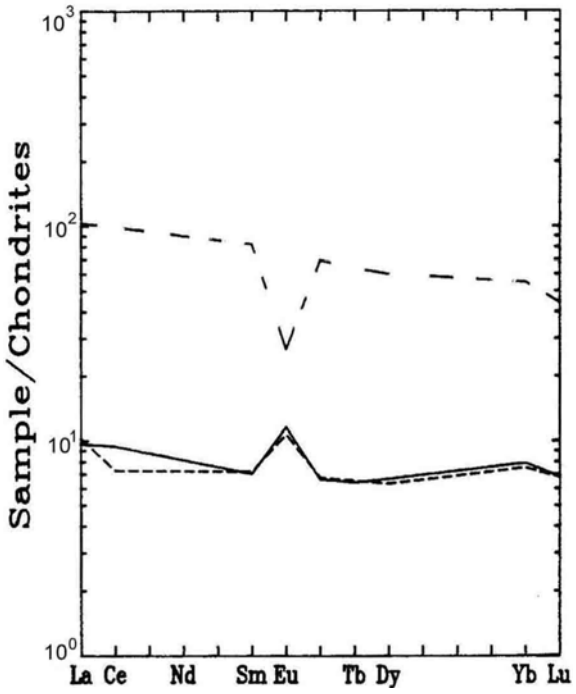


Figure 4: Rare earth elements in two samples of 72559 (bottom) and typical LKFM from Station 2 boulders (upper). Solid line from Warren and Wasson (1978), short-dash line from Murali et a1. (1977a). (LKFM, wide dash line).