72559

Granoblastic Impactite

27.8 grams

Figure 1: Photo of 72559 showing heavily cratered surface. Sample is about 4 cm across. NASA S73-33433.

Introduction

Lunar sample 72559 is a rake sample collected from the landslide material off of the South Massif, Apollo 17 (Ryder 1993). It is rounded and pitted by micrometeorite bombardment (figure 1). The internal texture is that of an annealed feldspathic impactite (figure 2). It has high Ir content, but no admixed KREEP component. It has not been dated.

Petrography

Nehru et al. (1978) and Warner et al. (1978) describe 72559 as a impact melt derived from anorthositic, troctolitic material while Ryder (1993) describe it as a recrystallized norite. Nehru et al. describe the mineralogy as 75% plagioclase ($An_{96.5}$), 15% olivine (Fo_{81}) and 10% orthopyroxene (Wo_4En_{80}), with minor augite, Mg-Al spinel, chromite, armalcolite, ilmenite, zircon, K-feldspar, metal and troilite. Larger grains of plagioclase and olivine are set in a finer-grained granoblastic groundmass made up of plagioclase,

Mineralogical Mode for 72559

	Warner et al. 1978	Nehru et al. 1978
Olivine	14.4 %	14.4
Pyroxene	10.5	10.2
Plagioclase	74.5	74.5
Opaque	0.6	

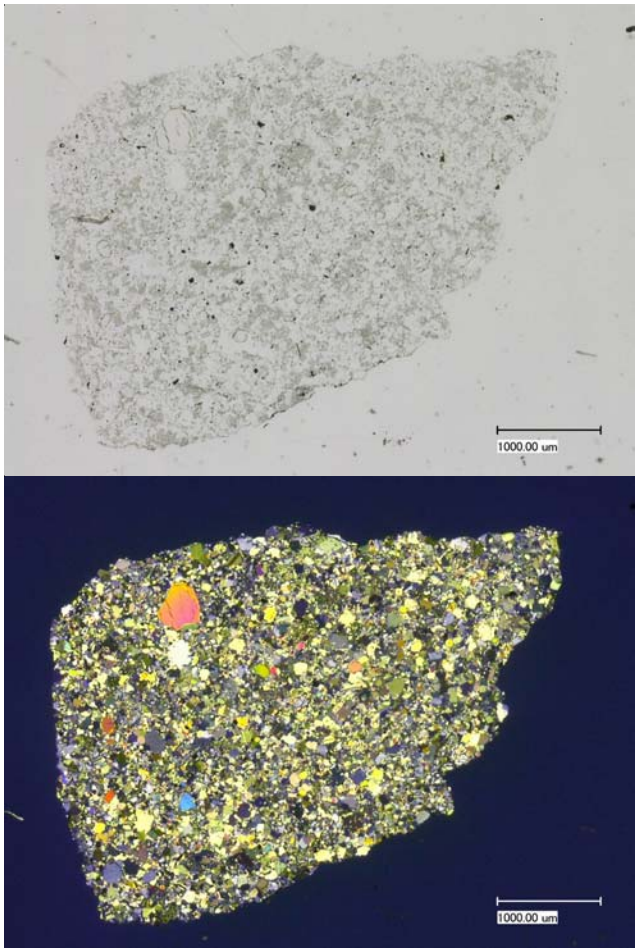

Figure 2a: Photomicrographs of 72559,7 by C Meyer @50x.

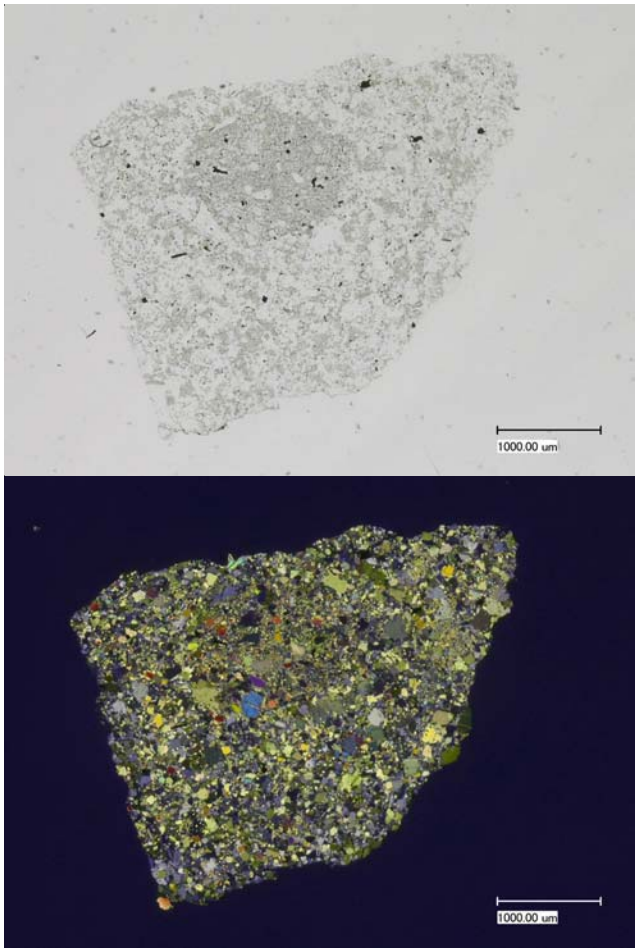

Figure 2b: Photomicrographs of 72559,8 by C Meyer @50x.

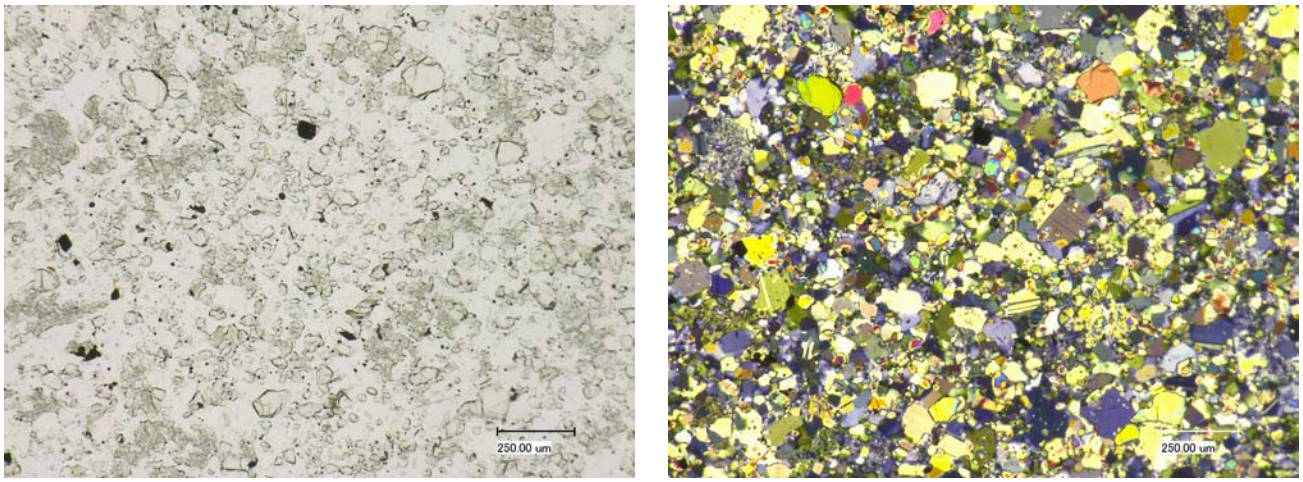

Figure 2c: Photomicrographs of 72559,7 by C Meyer @150x.

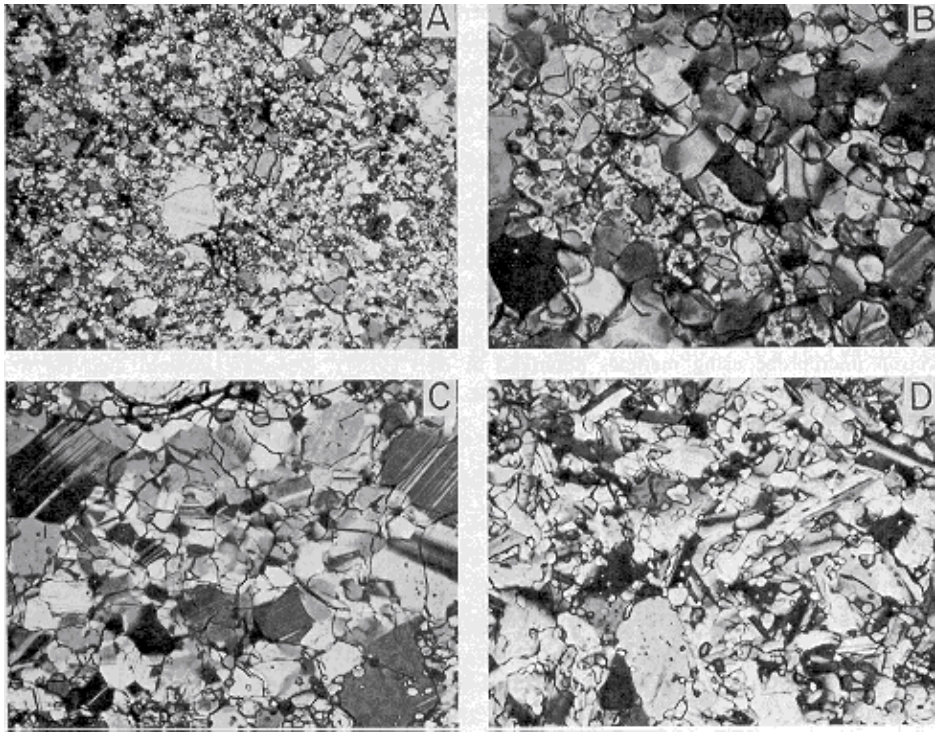

Figure 2: Thin section photomicrographs illustrating recrystallized texture of anorthositic troctolite 72559, a) field of view is 2.4 mm, b) matrix texture 0.45 mm, c) granoblastic clast 0.9 mm, d) troctolite clast 0.9 mm (from Nehru et al. 1978).

olivine and orthopyroxene (figure 3). The recrystallized and annealed groundmass is distinguished by triple-junction grain boundaries and larger poikilitic orthopyroxene enclosing smaller plagioclase and olivine.

Relict clasts of anorthosite and troctolite are discernable as distinct regions, but the mineral composition of both are similar (Nehru et al. 1978).

The textural evidence and mineralogical evidence suggest that a fairly homogeneous KREEP-free source was brecciated and thermally metamorphosed (Ryder 1993). Cushing et al. (1999) determined equilibrium temperature of 72559 from pyroxene composition as 1055 deg. C.

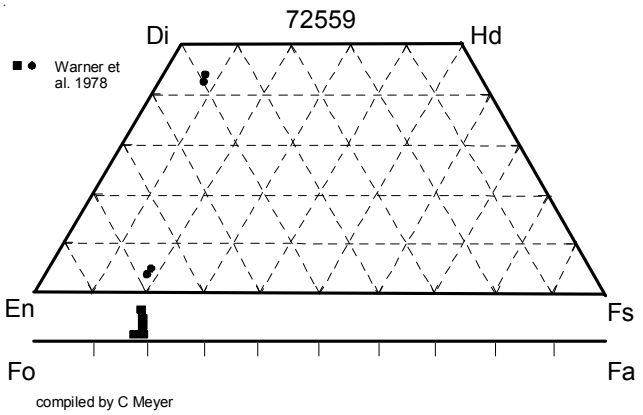

Figure 3: Pyroxene and olivine composition of 72559 (from Nehru et al. 1978).

Mineralogy

Olivine: The composition of olivine grains in 72559 are found to be extremely restricted ($Fo_{81\pm0.5}$).

Pyroxene: Orthopyroxene ($Wo_{3-4}En_{79-81}Fs_{16-17}$) and augite ($Wo_{42-44}En_{48-49}Fs_{8}$) form tight compositional clusters (figure 4). Pyroxene in 72559 is not exsolved (Nehru et al. 1978). Cushing et al. (1999) precisely determined the composition of pyroxene pairs to get a temperature.

Plagioclase: The larger grains of plagioclase are An_{98-96} while matrix plagioclase is An_{96-94}.

Zircon: Zircon is a rare matrix phase and occurs as irregular grains (Nehru et al. 1978).

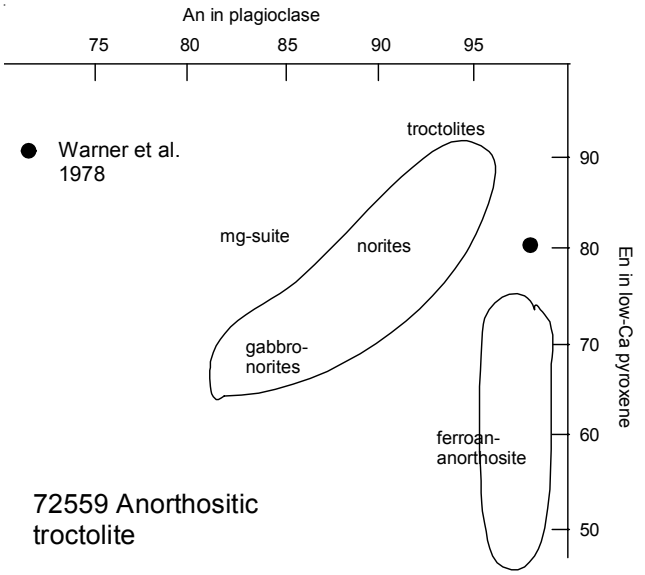

Figure 4: Pyroxene - plagioclase diagram showing position of lunar plutonic rock types and 72559.

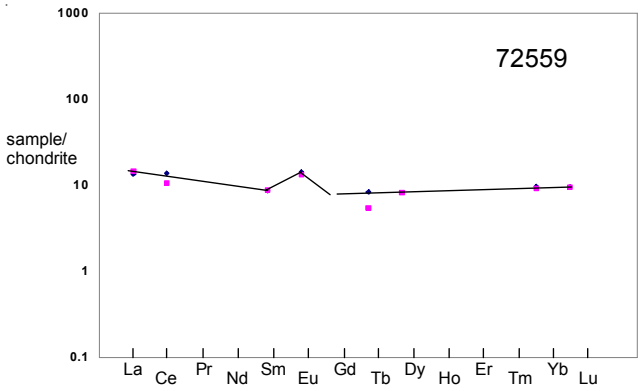

Figure 5: Normalized rare-earth-element composition of 72559 (from Murali et al. 1977 and Warren et al. 1978).

Opaques: Ilmenite, chromite and Mg-Al spinel have variable composition.

Armalcolite: Armalcolite is seen breaking down to rutile and ilmenite (Nehru et al. 1978).

Metallic iron: Metal grains generally contain Ni = 6%, Co = 0.7%, but areas with Ni = 22-34% are reported. One grain of taenite was reported (Nehru et al. 1978).

Chemistry

Two different analyses give consistent results (Murali et al. 1977, Warren et al. 1978). 72559 has low trace element content (figure 6), but high Ir (table 1).

Radiogenic age dating

None

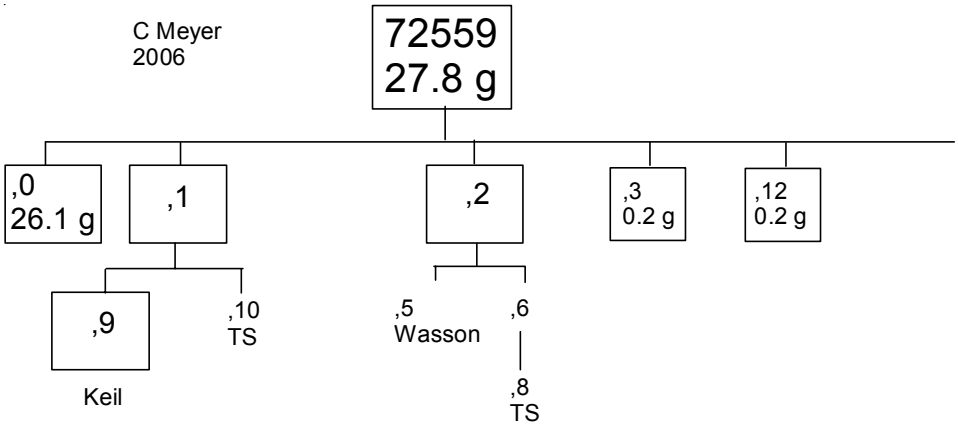

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Table 1. Chemical composition of 72559.

reference	Nehru 78		Murali 77		Warren 78	
weight			,1		,5	
SiO2 %	45				42.4	
TiO2	0.2	(a)	0.2	(b)	0.2	(d)
Al2O3	25.2	(a)	25.2	(b)	28.5	(d)
FeO	5.3	(a)	5.3	(b)	4.7	(d)
MnO	0.06	(a)	0.055	(b)	0.05	(d)
MgO	10	(a)	10	(b)	8.41	(d)
CaO	13.7	(a)	13.7	(b)	15.3	(d)
Na2O	0.3	(a)	0.3	(b)	0.35	(d)
K2O	0.09	(a)	0.093	(b)	0.1	(d)
P2O5						
S %						
sum						
Sc ppm			5.5	(b)	6.5	(c)
V			20	(b)		
Cr	890	(a)			960	(c)
Co			32	(b)	37	(c)
Ni			470	(b)	494	(c)
Cu						
Zn					5.4	(c)
Ga					3.93	(c)
Ge ppb					119	(c)
As						
Se						
Rb						
Sr						
Y						
Zr						
Nb						
Mo						
Ru						
Rh						
Pd ppb						
Ag ppb						
Cd ppb					27	(c)
In ppb					2.6	(c)
Sn ppb						
Sb ppb						
Te ppb						
Cs ppm						
Ba			59	(b)	70	(c)
La			3.4	(b)	3.2	(c)
Ce			6.4	(b)	8.3	(c)
Pr						
Nd						
Sm			1.3	(b)	1.27	(c)
Eu			0.74	(b)	0.8	(c)
Gd						
Tb			0.2	(b)	0.3	(c)
Dy			2	(b)		
Ho						
Er						
Tm						
Yb			1.5	(b)	1.58	(c)
Lu			0.23	(b)	0.23	(c)
Hf			1.4	(b)	1.3	(c)
Ta			0.4	(b)		
W ppb						
Re ppb						
Os ppb						
Ir ppb			16	(b)	13.6	(c)
Pt ppb						
Au ppb			5	(b)	26.7	(c)
Th ppm			0.3	(b)	0.77	(c)
U ppm					0.23	(c)

technique: (a) , (b) INAA, (c) RNAA, (d) fused bead elec. Probe

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