15385 and 15387

Picritic Basalt

8.7 and 2.0 grams

Figure 1: Photo of 15385. NASA S71-49189. Sample is about 2 cm.

Figure 2: Photo of 15387. NASA S71-49050. Sample is about 1 cm.

Introduction

Lunar samples 15385 and 15387 were collected as part of a rake sample from the rim of Spur Crater (part way up the Apennine Front). These small samples are found to have high Mg content, probably due to olivine accumulation (another "picritic basalt" from Apollo 15 is found as a large clast in breccia sample 15459). The formation of 15385 has been dated at 3.4 b.y. with exposure to cosmic rays for about 280 m.y.

Petrography

Ryder (1985) reported that 15385 and 15387 were probably pieces of the same coarse, friable basalt. They are similar in texture, chemical composition and mineralogy (figure 3).

Nehru et al. (1973) wrote: "The two feldspathic peridotites appear to be cumulates enriched in early olivine crystals (Dowty et al. 1973). Rock 15385 has abundant small, usually euhedral chromite grains. They often form clusters and are commonly present in early olivine, but also in the groundmass. Ulvospinel is subhedral to anhedral and is present in some of the later-formed major minerals, but mainly in the groundmass. Some ulvospinel-ilmenite intergrowths were observed. Rock 15387 is similar to 15385, but has less chromite and more ulvospinel."

"In both rocks chromite seems to grade compositionally into ulvospinel, and the compositional gap of the pyroxene-phyric and olivine-phyric basalts and olivine microgabbros is not apparent (figure 5). Some grains are intermediate in composition between chromite and ulvospinel. During crystallization, Cr_2O_3 and MgO decrease markedly, whereas TiO_2 and FeO increase sharply. Chromite has a relatively low *Cm* percentage and ulvospinel a relatively low *Uv* percentage such that titanian chromite grades into chromian ulvospinel"(figure 5).

Mineralogy

Olivine: Olivine grains (Fo_{62}) are large and rounded with abundant chromite inclusions. Some have melt inclusions. The relatively high Ca content of olivine in 15387 indicates that this is not a plutonic rock (Ryder 1985).

Pyroxene: Dowty et al. (1973) determined the composition of pyroxene in 15385 and 15387 (figure 4). Pyroxene grains are large and euhedral and may also be of "cumulate" origin.

Plagioclase: Plagioclase composition ranges from An_{80-95}.

Mineralogical Mode of 15385

	Dowty et al. 1973	15387
Olivine	30	34
Pyroxene	41	39
Plagioclase	20	22
Opaques	8	5

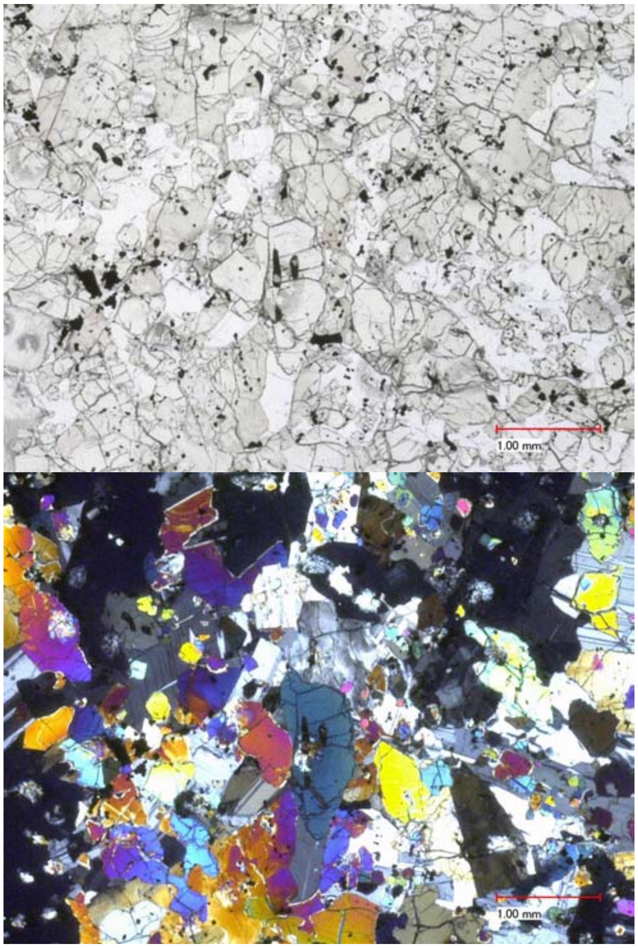


Figure 3: Photomicrographs of thin section 15385,9 by C Meyer @ 50x.

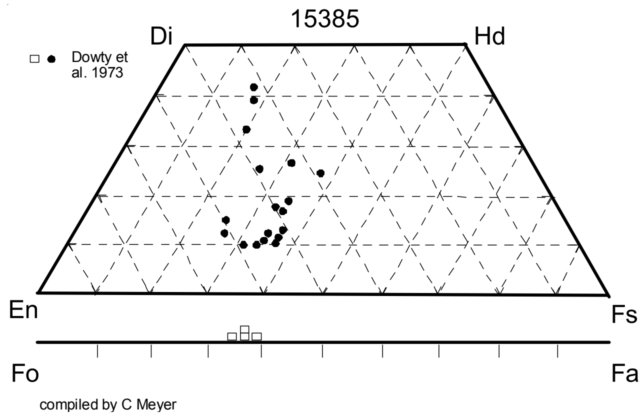


Figure 4a: Composition of pyroxene in 15385.

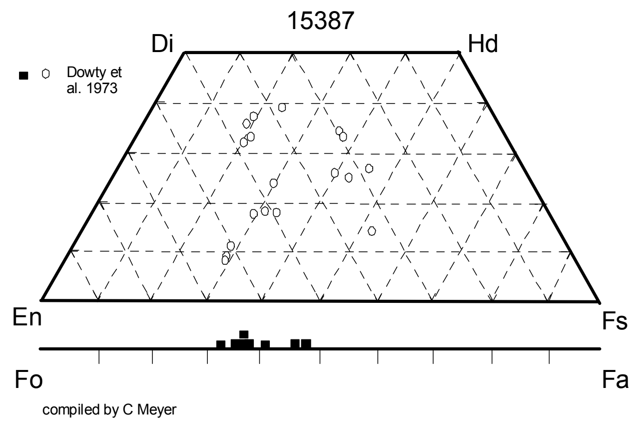


Figure 4b: Composition of pyroxene in 15387.

Ilmenite: Ilmenite in 15385 has high MgO content (3-5%).

Spinel: Nehru et al. (1974) found that chromite-ulvospinel grains formed a complete solid solution (figure 5).

Metalic Iron: Dowty et al. (1973) reported iron grains were 13-28% Ni and 1.5-2.5% Co.

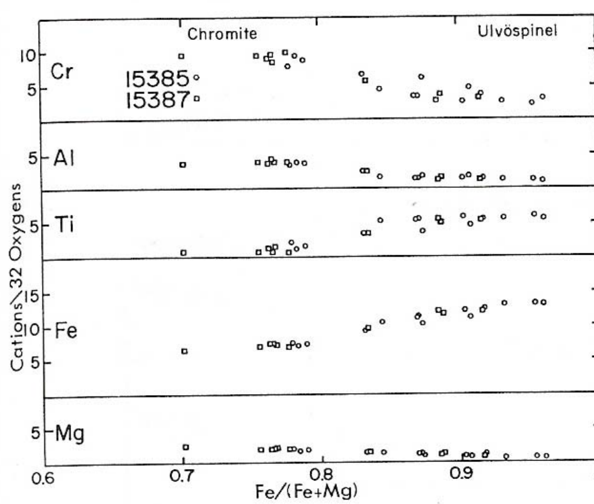


Figure 5: Composition of spinel in 15385 and 15387 (Nehru et al. 1974).

Chemistry

15385 has a high content of MgO as compared with other Apollo 15 basalts (figure 6). Ryder and Steele (1988) confirmed the results of Rhodes and Hubbard (1973) and Ma et al. (1976). These two samples are probably basalts with added olivine (figure 10).

Radiogenic age dating

Husain (1974) reported an Ar/Ar plateau age of 3.39 ± 0.06 b.y. (figure 8) and Snyder et al. (1997) obtained a Sm/Nd internal isochron age of about 3.5 b.y. (figure 9).

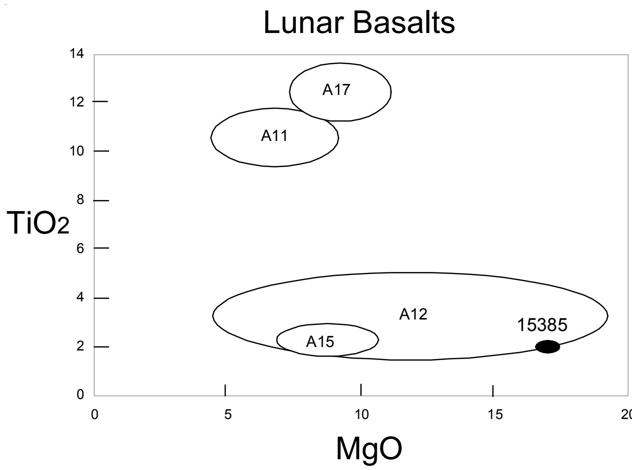


Figure 6: Chemical composition of 15385 compared with that of other luanr basalts.

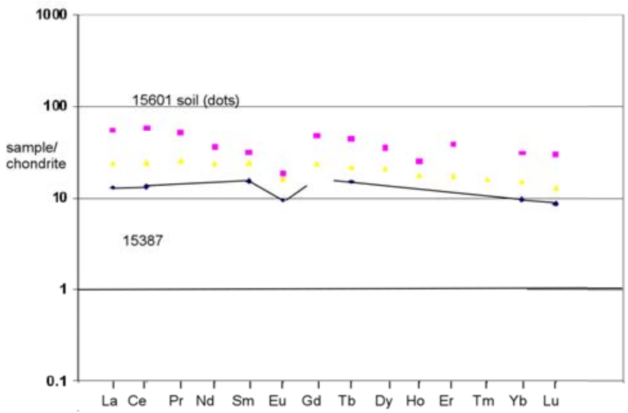


Figure 7: Normalized rare-earth-element diagram for 15387, with 15601 soil for comparison.

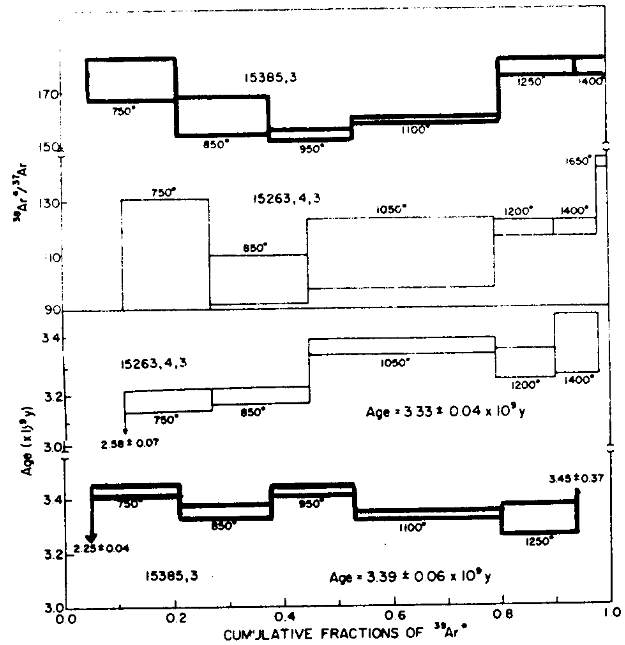


Figure 8: Ar/Ar relase diagram for 15385 and 15263,4,3 (from Husain 1974).

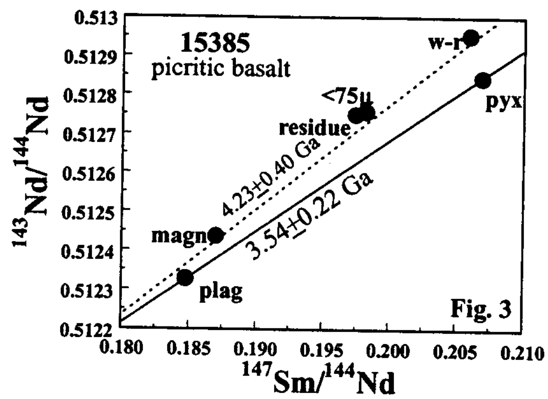


Figure 9: Isochron diagram for 15385 (from Snyder et al. 1997)

Lee et al. (1997) reported the isotopic composition of tungsten.

Cosmogenic isotopes and exposure ages

Husain et al. (1974) determined a cosmic ray exposure age (^{38}Ar) of about 280 m.y.

Summary of Age Data for 15385

	Ar/Ar	Sm/Nd
Husain 1974	3.39 ± 0.06 b.y.	
Snyder et al. 1997		~3.54

Table 1. Chemical composition of 15385.

reference	Wiesmann75		Rhodes73		Ma76		Dowty72	
weight	Rhodes73							
SiO2 %			40.72	(b)			41.4	(c)
TiO2	2.57	(a)	2.68	(b)	1.7	(d)	1.99	(c)
Al2O3			4.81	(b)	6.8	(d)	8.8	(c)
FeO			25.25	(b)	23.1	(d)	21.2	(c)
MnO			0.32	(b)				
MgO			17.66	(b)	18.2	(d)	16.9	(c)
CaO			6.48	(b)	6.8	(d)	7.3	(c)
Na2O	0.15	(a)	0.15	(b)	0.22	(d)	0.32	(c)
K2O	0.058	(a)	0.06	(b)	0.033	(d)		
P2O5			0.08	(b)			0.03	(c)
S %			0.1	(b)				
sum								
Sc ppm					39	(d)		
V					187	(d)		
Cr	4272	(a)			5030	(d)	5550	(c)
Co					64	(d)		
Ni					138	(d)		
Cu								
Zn								
Ga								
Ge ppb								
As								
Se								
Rb	1.11	(a)						
Sr	79	(a)						
Y								
Zr	106	(a)						
Nb								
Mo								
Ru								
Rh								
Pd ppb								
Ag ppb								
Cd ppb								
In ppb								
Sn ppb								
Sb ppb								
Te ppb								
Cs ppm								
Ba	63.8	(a)			57	(d)		
La	6.96	(a)			4	(d)		
Ce	18	(a)						
Pr								
Nd	13.4	(a)						
Sm	4.51	(a)			2.6	(d)		
Eu	0.873	(a)			0.67	(d)		
Gd	6.08	(a)						
Tb					0.57	(d)		
Dy	5.89	(a)			2.3	(d)		
Ho								
Er	3.19	(a)						
Tm								
Yb	2.72	(a)			1.7	(d)		
Lu					0.29	(d)		
Hf	3.3	(a)			2.2	(d)		
Ta					1.84	(d)		
W ppb								
Re ppb								
Os ppb								
Ir ppb								
Pt ppb								
Au ppb								
Th ppm	0.62	(a)						
U ppm	0.18	(a)						

technique: (a) IDMS, (b) XRF, (c) broad beam elec. Probe, (d) INAA

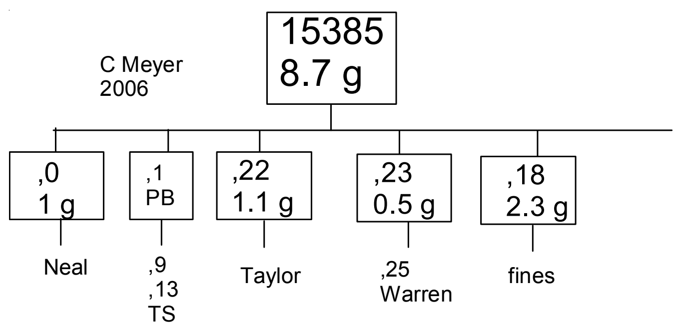
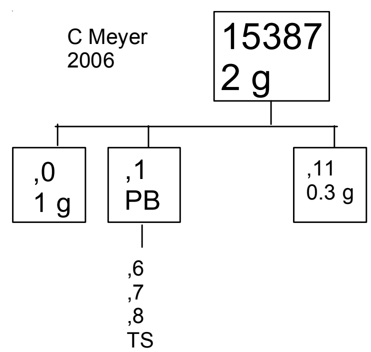


Table 2. Chemical composition of 15387.

reference	Ryder and Steele88			Bunch72	Dowty72	
weight						
SiO2 %	45.3	47.6	(a)	41.9	4.18	(c)
TiO2	1.67	1.44	(a)	1.12	1.44	(c)
Al2O3	5.8	5.5	(a)	10	7.7	(c)
FeO	22.7	21	(a)	22.5	23.9	(c)
MnO	0.29	0.25	(a)	0.27	0.28	(c)
MgO	17.4	16.9	(a)	17.1	18.1	(c)
CaO	6.4	6.2	(a)	7.5	7	(c)
Na2O	0.16	0.12	(a)	0.27	0.28	(c)
K2O				0.01	0.01	(c)
P2O5	0.11	0.08	(a)	0.03	0.04	(c)
S %						
sum						
Sc ppm	28.5	30.4	(b)			
V						
Cr	3660	4609	(b)	3700	3700	(c)
Co	66.5	66.4	(b)			
Ni						
Cu						
Zn						
Ga						
Ge ppb						
As						
Se						
Rb						
Sr						
Y						
Zr						
Nb						
Mo						
Ru						
Rh						
Pd ppb						
Ag ppb						
Cd ppb						
In ppb						
Sn ppb						
Sb ppb						
Te ppb						
Cs ppm						
Ba						
La	3.02	2.8	(b)			
Ce	7.9	7.6	(b)			
Pr						
Nd						
Sm	2.22	2.07	(b)			
Eu	0.524	0.52	(b)			
Gd						
Tb	0.54	0.48	(b)			
Dy						
Ho						
Er						
Tm						
Yb	1.54	1.47	(b)			
Lu	0.21	0.19	(b)			
Hf	1.7	1.6	(b)			
Ta						
W ppb						
Re ppb						
Os ppb						
Ir ppb						
Pt ppb						
Au ppb						
Th ppm	0.39	0.39	(b)			
U ppm						

technique: (a) fused bead elec. Probe, (b) INAA, (c) broad beam elec. Probe



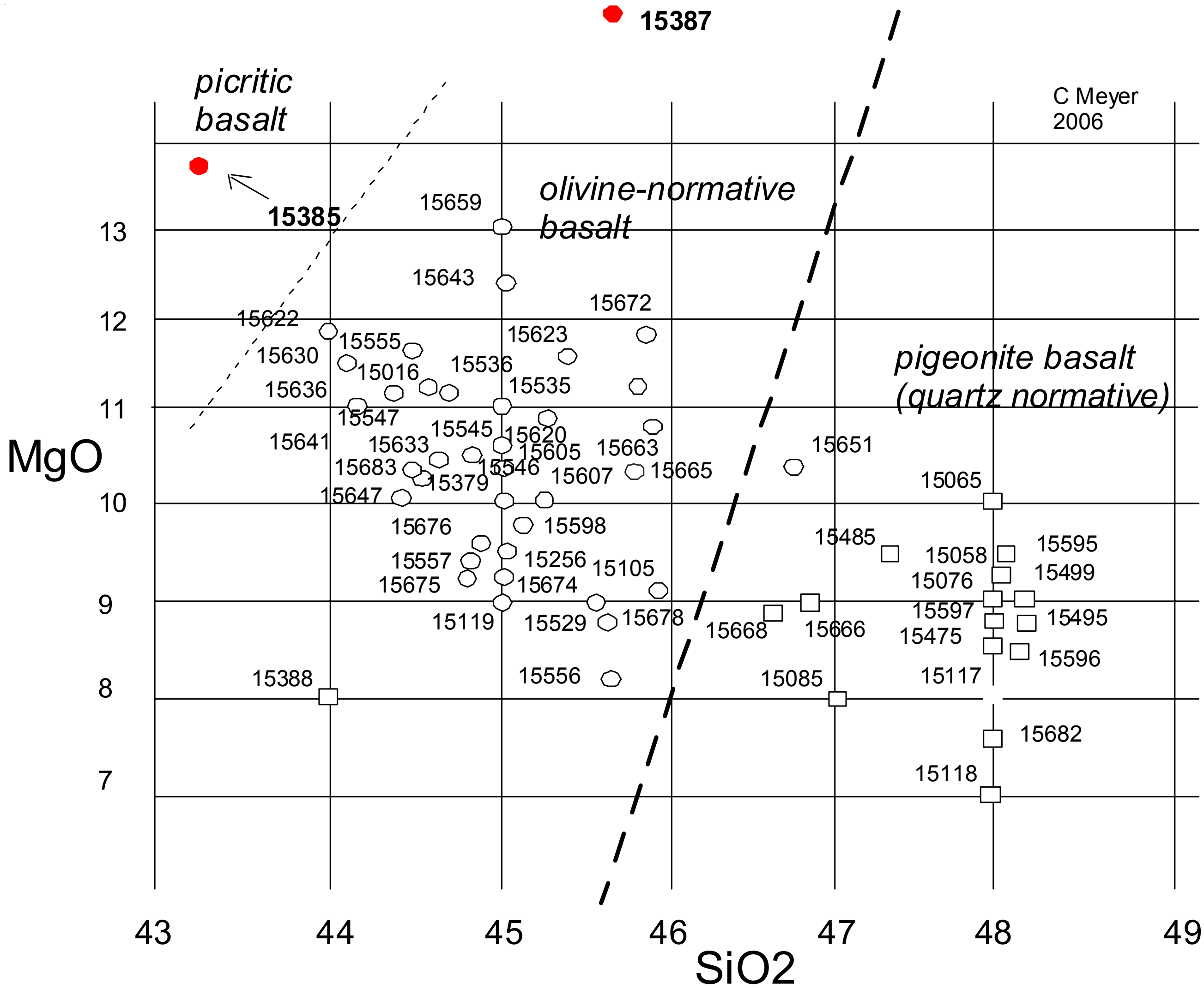


Figure 10: Composition of Apollo 15 basalts with 15385 anbd 15387 highlighted. They appear to have added olivine.

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