15295

Regolith Breccia

947 grams

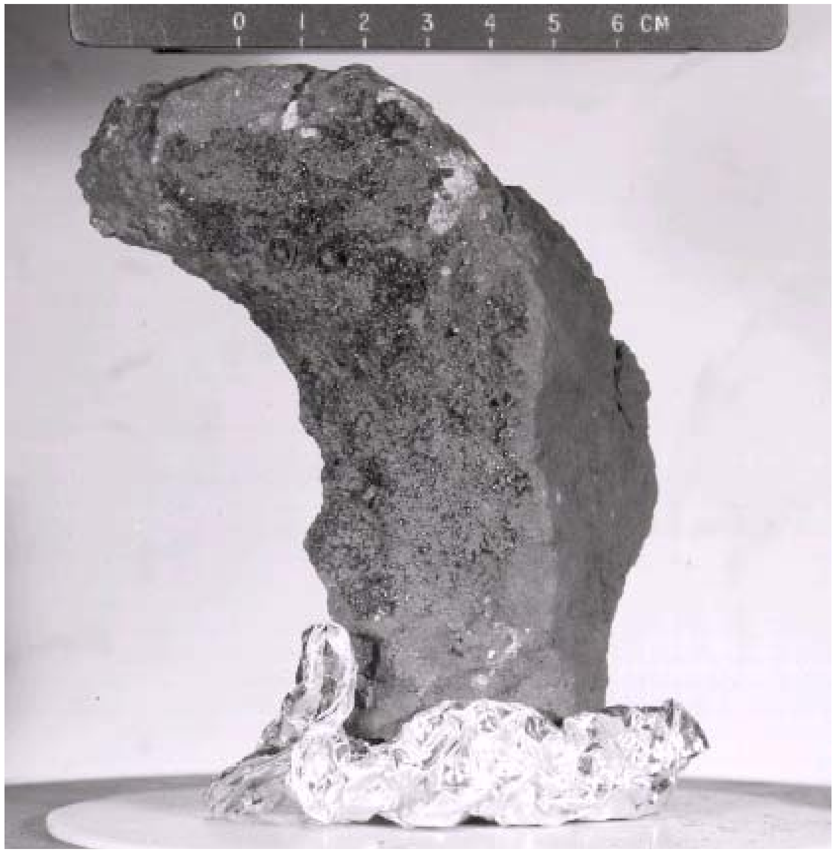

Figure 1: Photo of lunar regolith breccia 15295. NASA photo # S71-51701. Scale in cm.

Introduction

15295 is a brown glass matrix breccia made of local soil components. It was one of several breccias, all similar, collected at station 6, near Spur carter, part way up the slope of Hadley-Delta.

Part of the surface of 15295 is covered with a frothy black glass coating (figure 1). Interior veins of flow-banded green glass were reported by Wilshire and Moore (1974).

15295 is one of the soil breccias studied carefully by Simon et al. (1986) and McKay et al. (1989). The Apollo 15 catalog by Ryder (1985) contains additional information.

Petrography

Simon et al. (1986) compares the mineralogical mode, pyroxene and olivine analyses (figure 5), plagioclase analyses, etc. for mineral fragments in 15295 with that of other Apollo 15 breccias. They found that the abundance of calcic plagioclase was the best indication of added highland component. Simon et al. also studied the glass compositions of the Apollo 15 breccias, but grouped the data for all the rocks together. In any case, they showed that the regolith breccias from Apollo 15, station 6, contain numerous glasses from various fire fountains (compositional clusters), such as formed the Apollo 15 green glass (Meyer et al. 1975, Delano and Livi 1981).

Warren (1993) tabulates five clasts found in 15295.

Anothosite clast

Warren and Wasson (1978) studied a "large" anorthositic clast (20 x 7 x 9 mm) in 15295 (figures 1 and 2). The texture is described as "cataclastic" with mostly plagioclase ($An_{95.5}$), and sparse, tiny, pyroxenes

Figure 2: Close-up photo of 15295 showing glass coating, brown glass matrix and "large" chalky white clast (anorthosite). NASA S86-39938. Cube is 1 inch, but scale is in cm.

($En_{41}Fs_{17}Wo_{42}$). Ir is low, so clast is considered "pristine".

Norite clast ,67

Lindstrom et al. (1989) analyzed a relatively coarse-grained (1.6 mm !) norite clast with plagioclase (An_{94}), pyroxene (En_{76}) and trace troilite, apatite, chromian rutile and a silica mineral reported (figure 6).

Norite clast ,85

Lindstrom et al. (1989) also studied a second norite clast, 30% plagioclase (An_{94}) and 70% pyroxene (En_{75}) (figure 6).

Chemistry

Wanke et al. (1977), Simon et al. (1986), Korotev in McKay et al. (1989) give analysis of matrix of 15295 (table 1, figure 7). Warren and Wasson (1978), Lindstrom et al. (1989) also analyzed several clasts.

Using the composition of 15295, Simon et al. (1986) calculate that it could be a mix of 6% anorthosite, 36% mare basalt, 40% LKFM, 21% KREEP with 0% green glass.

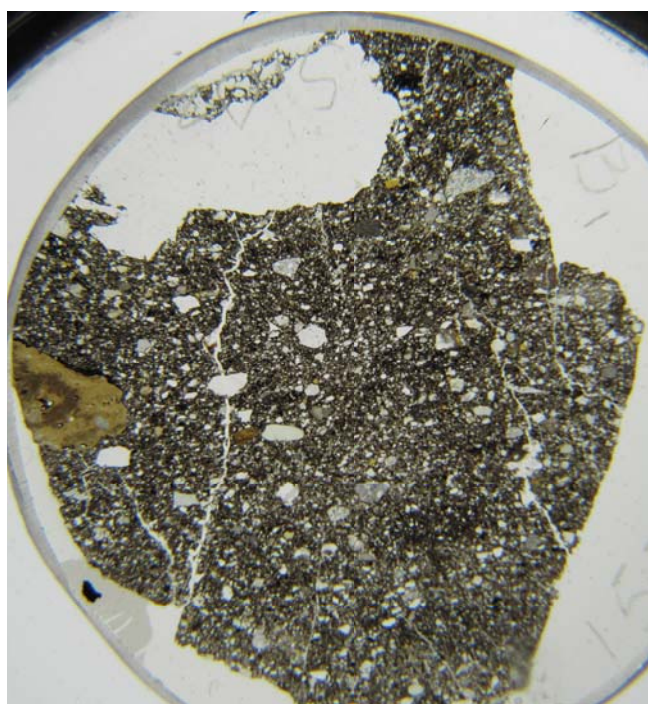

Figure 3a: Thin section 15295,29, as photographed by C Meyer with Canon digital camera. Field of view is 1 inch.

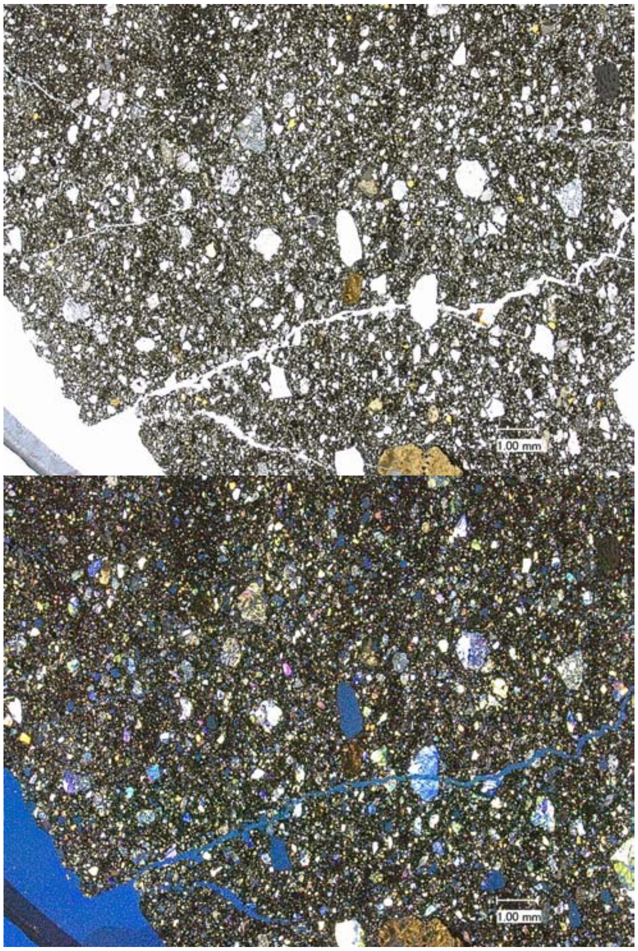

Figure 4: Photomicrographs of 15295,29 by C Meyer. Field of view is 1 inch.

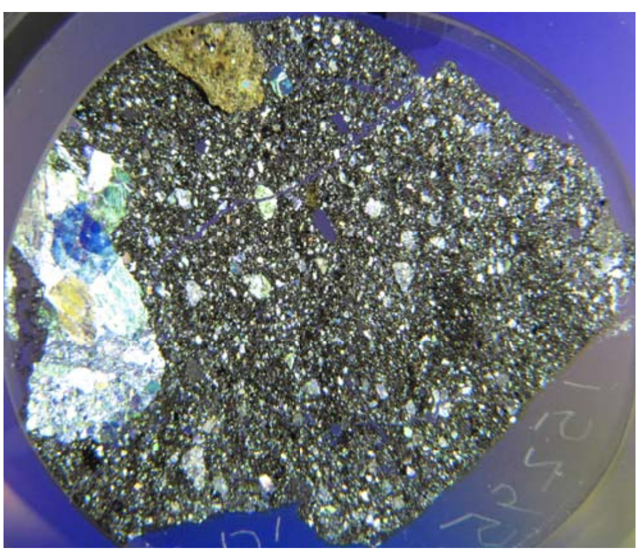

Figure 3b: Partially crossed polarizerd view, as photographed by C Meyer with Canon digital camera. Field of view is 1 inch.

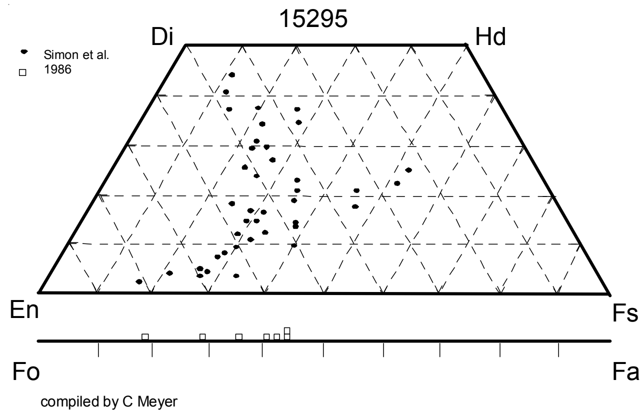

Figure 5: Olivine and pyroxene composition of mineral fragments in matrix of 15295 (replotted from Simon et al. 1986).

Other Studies

The rare gas content and isotopic composition of 15295 were determined by Bogard (in McKay et al. 1989).

Processing

15295 was chosen as one of the samples to be studied by the "Regolith Breccia Initiative" (Fruland 1983). It initially broke into several pieces in 1971. A saw cut was made in 1987.

List of Photo #s

S71-51701	
S86-39938	glass splash and anorthosite clast
S87-43485	sawn surface a norite clast
S87-43490	sawn surface

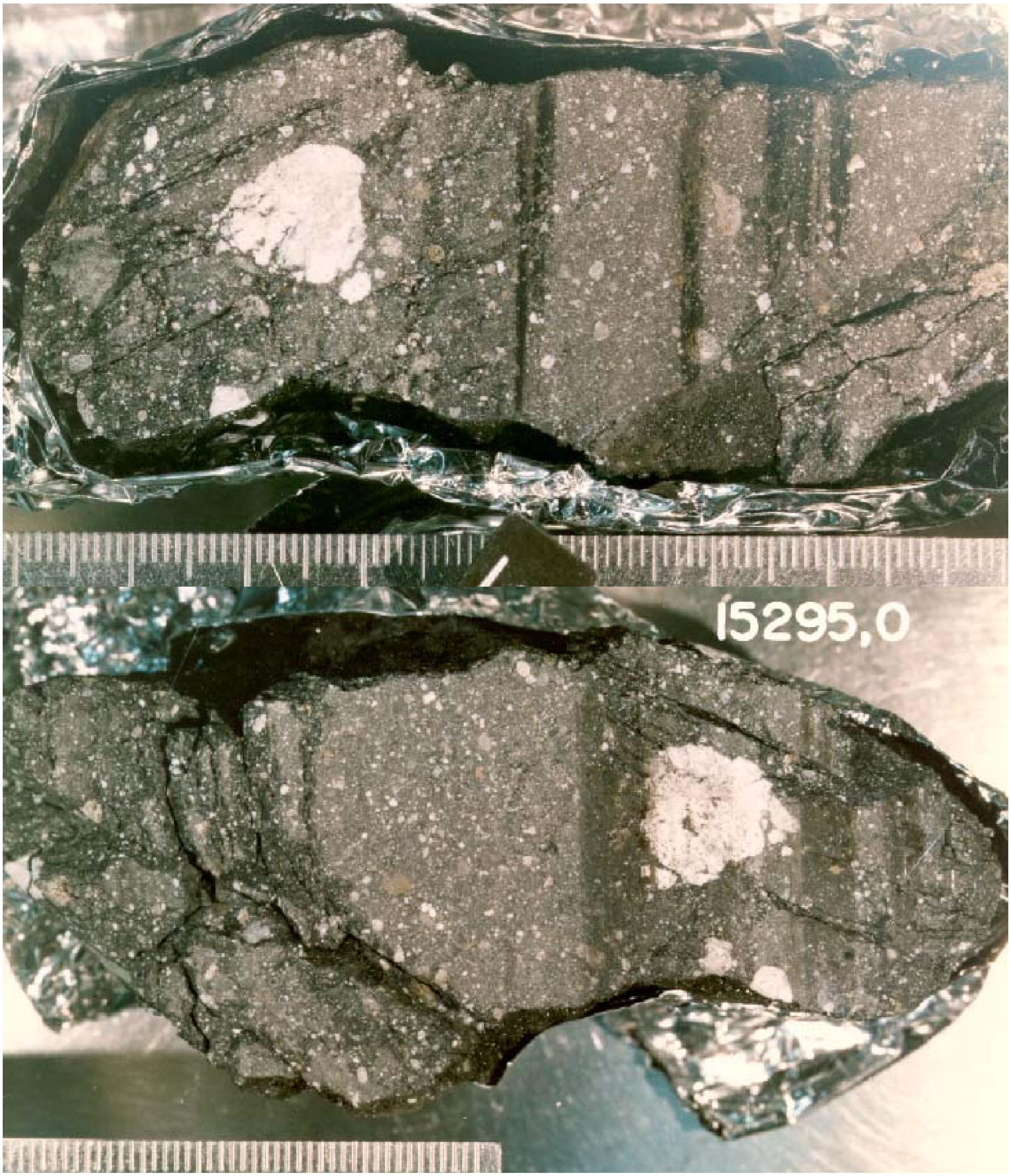

Figure 4: Photos of opposing sawn surfaces of 15295,0 and 15295,46. Scale is 1 cm. NASA S87-43485 and S87-43490. The large white clast is probably one of the norite clasts studied by Lindstrom et al. (1989).

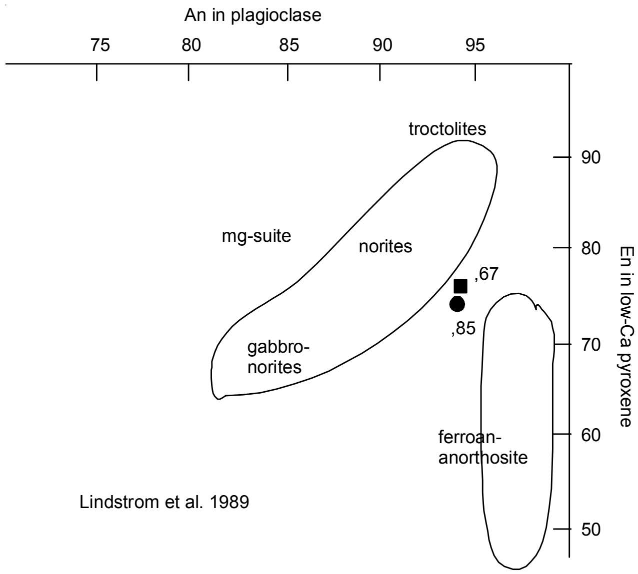

Figure 6: Plagioclase-pyroxene diagram for pristine rocks from lunar highlands showing norite clasts found in 15295 (Lindstrom et al. 1989).

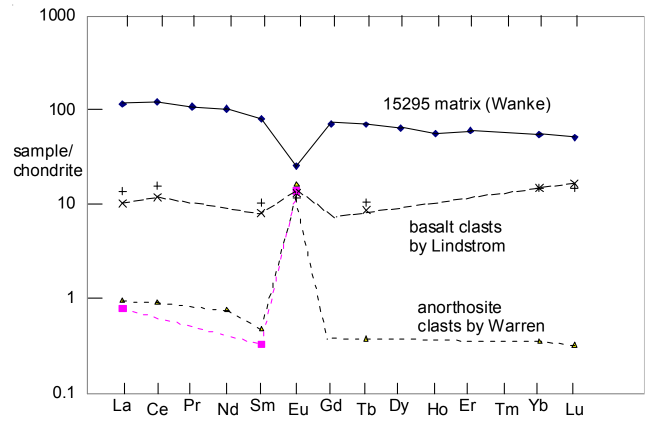

Figure 7: Normalized rare-earth-element diagram for matrix and clasts in 15295 (data from table 1).

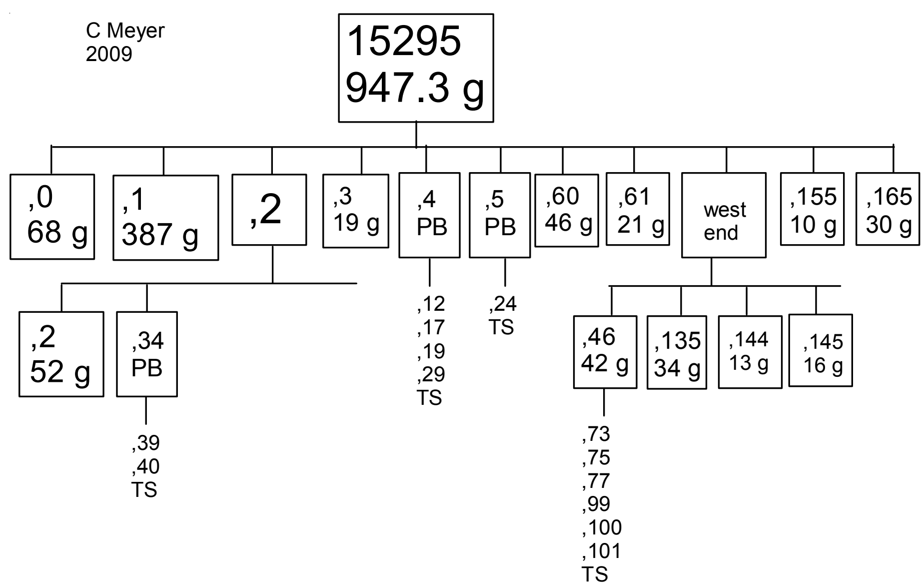

Table 1. Chemical composition of 15295.

	matrix	matrix	matrix	white clast	clast	clast	clast
reference	Wanke 77	McKay 89	Simon 86	Warren 78	Warren 90	Lindstrom 89	
weight	,20	,30	,35			,66	,86
SiO2 %	46.68			43.9	45.14	54.3	52.1
TiO2	1.48		1.6		<0.08	0.24	0.22
Al2O3	16.29		16.6	35.5	34.58	11.5	12
FeO	11.87	11.5	11.8	0.23	0.35	9.8	9.15
MnO	0.23		0.155		0.008		
MgO	10.24		11.7	0.18	0.3	15.9	17.8
CaO	11.33	10.8	11.1	19.5	19.48	7.1	7.2
Na2O	0.5	0.48	0.49	0.402	0.41	0.26	0.24
K2O	0.22		0.21		0.01	0.042	0.044
P2O5	0.22						
S %	0.06						
sum							
Sc ppm	24.7	22.2	23.7	0.38	5.3	18.5	15.7
V	77		85				
Cr	2440	2150	2360	17.8		3830	3270
Co	39.4	38.4	39	1.4	0.31	152	18.7
Ni	250	222	190	<15	0.17	100	76
Cu	4.72						
Zn	18			25.2	2		
Ga	4.17			3.97	3.5		
Ge ppb	500			8.2	1.9		
As	0.023						
Se	0.15						
Rb	5.7						
Sr	135	150	120		191		
Y	101						
Zr	394	380	340		45		
Nb	28						
Mo							
Ru							
Rh							
Pd ppb							
Ag ppb							
Cd ppb							
In ppb							
Sn ppb							
Sb ppb							
Te ppb							
Cs ppm	0.27	0.34			0.054		
Ba	279	266	270		8.9	41	55
La	27.7	24.1	26	0.19	0.23	2.44	3.24
Ce	74.3	63	65		0.56	7.3	9.7
Pr	9.83						
Nd	47	34	42		0.35		
Sm	12.1	11.1	11.9	0.049	0.072	1.21	1.54
Eu	1.47	1.41	1.45	0.78	0.94	0.74	0.66
Gd	14.2						
Tb	2.58	2.25	2.5		0.014	0.32	0.39
Dy	15.9		15.7				
Ho	3.2		3.4				
Er	9.75						
Tm			1.3				
Yb	9.07	7.8	8.6		0.058	2.5	2.45
Lu	1.26	1.11	1.22		0.008	0.42	0.37
Hf	9.65	9.4	8.25		1.03	1.07	1.6
Ta	1.17	1.08	1.1		<0.028	<0.13	0.16
W ppb	550						
Re ppb	0.71				0.022		
Os ppb					0.03		
Ir ppb		6.8		0.021	0.05		
Pt ppb							
Au ppb	2.9	2.2		0.041	0.094		
Th ppm	3.89	4	4.25		0.026	0.34	0.51
U ppm	1.04	1.08	1.1			0.34	0.2
technique	*(a) INAA*						

Table 2. Chemical composition of 15295 clasts.

reference	Lindstrm et al. 1990								
weight									
SiO2 %	45.4	45.5	45.8	45.1	46.6	45.2	45.3	45.7	(a)
TiO2	1.78	1.74	1.74	1.89	0.64	1.81	1.78	1.73	(a)
Al2O3	20.7	20.4	21.1	19.1	22.2	20.4	19.5	20.3	(a)
FeO	7.53	7.51	7.66	8.25	5.58	7.75	7.8	7.53	(a)
MnO									(a)
MgO	10.4	10.7	10.9	11.3	10.8	8.98	10.8	10.2	(a)
CaO	12	12.2	12.2	11.7	12.9	12.6	12.1	12.4	(a)
Na2O	0.55	0.62	0.71	0.62	0.46	0.63	0.6	0.62	(a)
K2O	0.05	0.11	0.13	0.14	0.14	0.16	0.12	0.14	(a)
P2O5	0.04	0.08	0.08	0.08	0.04	0.09	0.1	0.08	(a)
S %									
sum									
Sc ppm	18.7	17.5	17.4	17.8	10.6	17.8	17.6	17	(a)
V									
Cr	1300	1175	1100	1130	1220	1160	1180	1180	(a)
Co	22	20.3	20.6	21.4	15.1	19.2	20.3	19.2	(a)
Ni	79	58	78	70	138	100	61	57	(a)
Cu									
Zn									
Ga									
Ge ppb									
As									
Se									
Rb									
Sr	190	200	230	240	180	240	185	195	(a)
Y									
Zr									
Nb									
Mo									
Ru									
Rh									
Pd ppb									
Ag ppb									
Cd ppb									
In ppb									
Sn ppb									
Sb ppb									
Te ppb									
Cs ppm									
Ba	94	140	135	160	150	170	160	130	(a)
La	5.27	9.76	9.6	10.35	11.1	12.67	12.08	9.03	(a)
Ce	14.1	26	25.2	25.8	28.6	32.7	31.5	23.8	(a)
Pr									
Nd	8	12	15	20	17	18	15	13	(a)
Sm	2.78	4.88	4.77	5.11	5.01	5.87	5.8	4.42	(a)
Eu	1.5	1.73	1.74	1.71	1.15	1.74	1.61	1.63	(a)
Gd									
Tb	0.65	1.01	1.04	1.12	0.98	1.18	1.21	0.98	(a)
Dy									
Ho									
Er									
Tm									
Yb	2.78	4.12	3.95	4.33	4.04	4.78	4.89	4.18	(a)
Lu	0.429	0.607	0.6	0.644	0.54	0.702	0.718	0.58	(a)
Hf	2.78	3.86	3.66	4.1	4	4.47	4.57	3.78	(a)
Ta	0.43	0.62	0.6	0.66	0.5	0.67	0.65	0.61	(a)
W ppb									
Re ppb									
Os ppb									
Ir ppb	2.5	2	1.5	2.5	6.6	3	6	1.5	(a)
Pt ppb									
Au ppb									
Th ppm	0.79	1.97	1.79	1.98	1.99	2.15	2.12	1.75	(a)
U ppm	0.22	0.42	0.48	0.47	0.55	0.66	0.62	0.45	(a)

technique : (a) INAA

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