DRAFT

12011

Pigeonite Basalt

193 grams

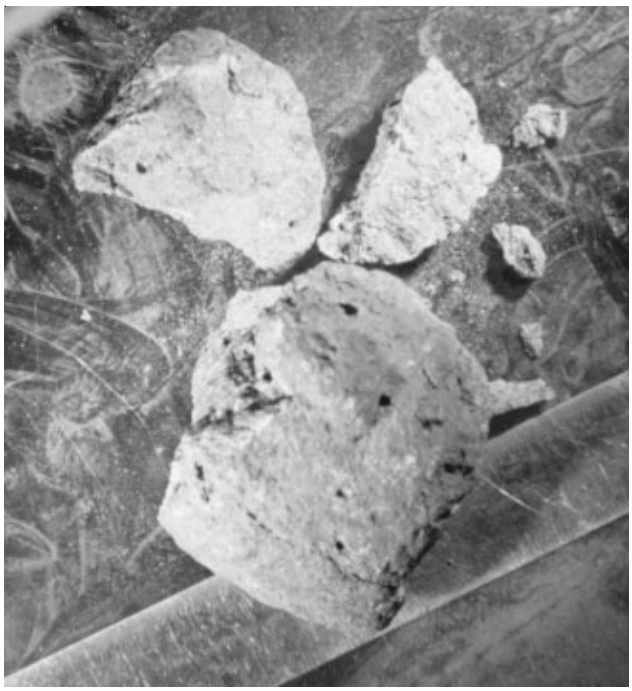

Figure 1: Photo of 12011. NASA # S69-64122. Sample is 5 cm.

Introduction

12011 is a porphyritic pigeonite basalt. It had an encrustation of dirt (figure 1) and numerous micrometeorite pits (figure 2).

Petrography

The petrology of 12011 is discussed in Baldridge et al. (1979). Phenocrysts of olivine (1 mm) and pyroxene (up to 4 mm long) and microphenocrysts of chromite occur in a "fine-grained, variolitic-textured groundmass of pyroxene, plagioclase, ilmenite, ulvöspinel, metallic iron and mesostasis."

Mineralogical Mode of 12011

	Baldridge et al. 1979	Neal et al. 1994
Olivine	7.7	7.6
Pyroxene	53	52.9
Plagioclase	31	30.6
Ilmenite	2.9	2.9
Chromite	0.5	0.6
"silica"	3.4	3.4
mesostasis	1.2	1.4

Mineralogy

Olivine: Baldridge et al. (1979) state that "olivine compositions in 12011 range from Fo_{73-62} and some grains are zoned over almost this entire range."

Pyroxene: The pyroxene composition of 12011 is given by Baldridge et al. (1979) (figure 3). Pigeonite cores are rimmed by augite. Some pigeonite phenocrysts are long and "hollow".

Plagioclase: The average composition of plagioclase in 12011 is An_{78}.

Ilmenite: Fine needles of ilmenite form a network in the mesostasis.

Chemistry

The chemical composition of 12011 has been determined by Rhodes et al. (1977) and Snyder et al.

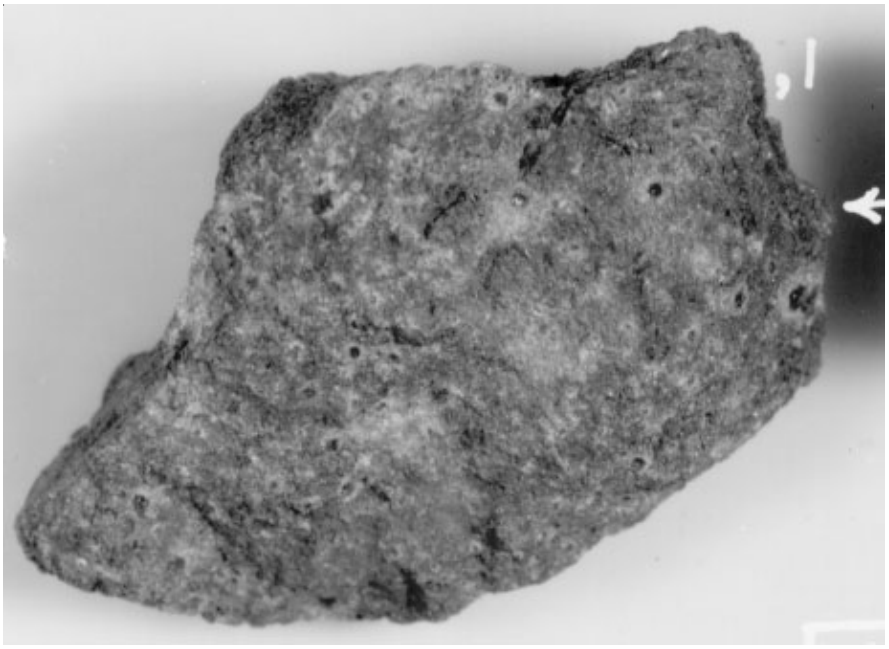

Figure 2: Closeup of 12011,1 showing "zap pits". NASA #S76-26081. Piece is 2.2 cm across.

(1997). Nyquist et al. (1977) determined the trace elements by isotope dilution (figure 5).

Radiogenic age dating

Snyder et al. (1997) reported the isotopic composition of Sr and Nd, but the age has not been determined.

Other Studies

Bogard et al. (1971) reported the content and isotopic composition of rare gases in 12011.

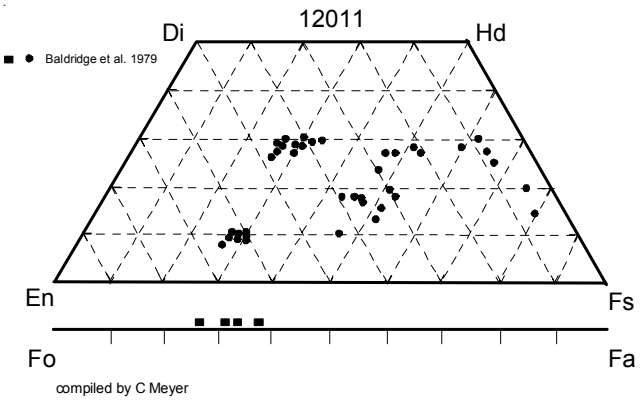

Figure 3: Pyroxene composition in 12011 (adapted from Baldridge et al 1979).

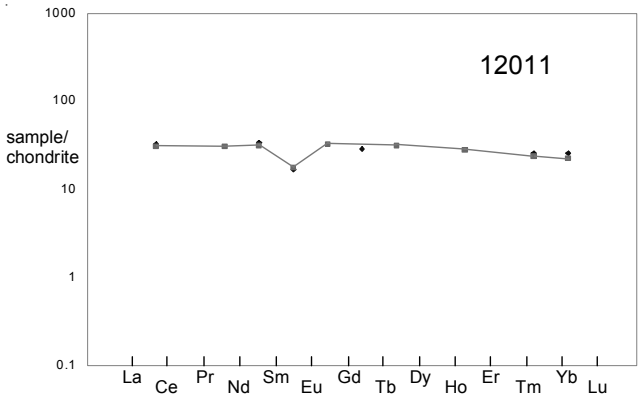

Figure 4: Normalized rare-earth-element composition diagram for 12011 (data from Rhodes et al. 1977, and Nyquist et al. 1979 (highlighted).

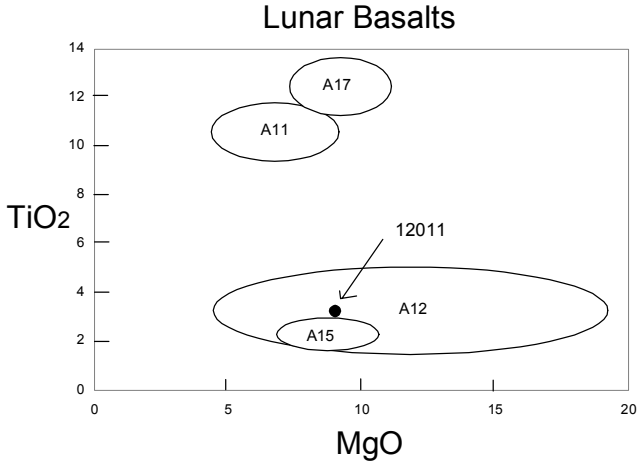

Figure 5: Composition of lunar basalts with 12011 indicated.

List of Photo #s for 12011
S69-64096 – 64122
S70-53773 – 53778 TS

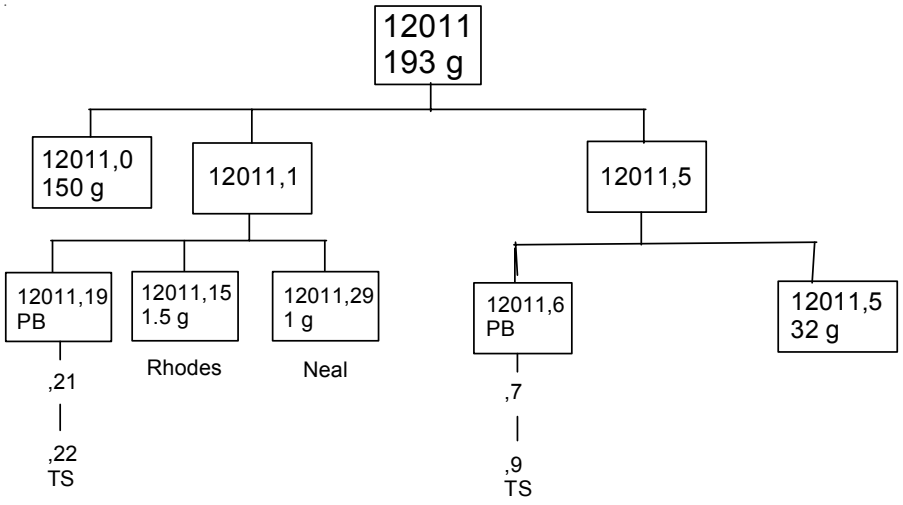

Table 1. Chemical composition of 12011.

reference	Rhodes77		Baldridge79		Nyquist79		Snyder97	
weight					59 mg			
SiO2 %	46.63	(c)	46.59	(d)			46.6	
TiO2	3.29	(c)	3.25	(d)			3.29	
Al2O3	9.77	(c)	10.02	(d)			9.77	
FeO	19.53	(c)	19.31	(d)			19.5	
MnO	0.29	(c)	0.28	(d)			0.29	
MgO	8.26	(c)	9.59	(d)			8.26	
CaO	10.63	(c)	10.55	(d)			10.6	
Na2O	0.25	(a)	0.33	(d)			0.25	
K2O	0.06	(c)	0.02	(d)	0.065	(b)	0.06	
P2O5	0.07	(c)	0.03	(d)			0.07	
S %	0.06	(c)						
sum								
Sc ppm	52.2	(a)						
V								
Cr	4050	(a)					2510	(e)
Co	39	(a)					47.7	(e)
Ni							30.9	(e)
Cu							14.9	(e)
Zn							13.2	(e)
Ga							4.2	(e)
Ge ppb								
As								
Se								
Rb					1.22	(b)	1.327	(e)
Sr	113	(c)			113	(b)	117.9	(e)
Y	39	(c)					38.4	(e)
Zr	128	(c)						
Nb	7.4	(c)						
Mo								
Ru								
Rh								
Pd ppb								
Ag ppb							191	(e)
Cd ppb								
In ppb								
Sn ppb								
Sb ppb								
Te ppb								
Cs ppm							0.072	(e)
Ba	71	(b)			70	(b)	79.1	(e)
La							7.77	(e)
Ce	19.9	(a)			18.5	(b)	18.5	(e)
Pr							2.79	(e)
Nd					14.1	(b)	14.2	(e)
Sm	5	(a)			4.78	(b)	4.8	(e)
Eu	0.95	(a)			1	(b)	1.11	(e)
Gd					6.47	(b)	5.22	(e)
Tb	1.06	(a)					0.94	(e)
Dy					7.72	(b)	5.87	(e)
Ho							1.32	(e)
Er					4.55	(b)	3.73	(e)
Tm							0.51	(e)
Yb	4.2	(a)			3.93	(b)	3.86	(e)
Lu	0.62	(a)			0.548	(b)	0.47	(e)
Hf	3.7	(a)						
Ta								
W ppb								
Re ppb								
Os ppb								
Ir ppb								
Pt ppb								
Au ppb								
Th ppm							0.415	(e)
U ppm							0.291	(e)

technique (a) INAA, (b) IDMS, (c) XRF, (d) from mode, (e) ICP-MS