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.

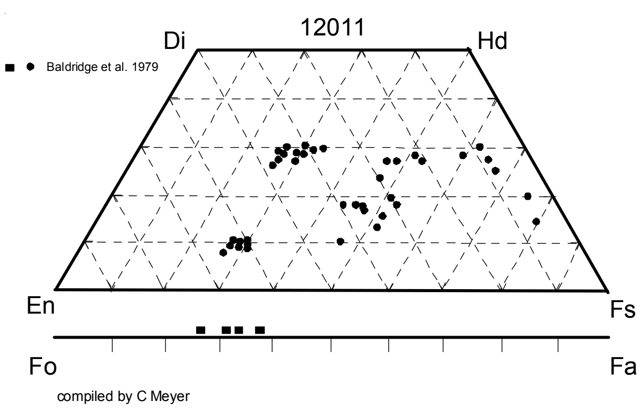

Figure 3: Pyroxene composition in 12011 (adapted from Baldridge et al 1979).

List of Photo #s for 12011

S69-64096 – 64122

S70-53773 – 53778 TS

S76-26081

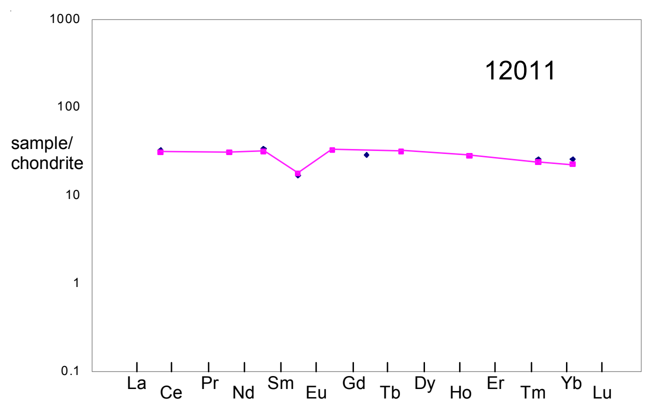

Figure 4: Normalized rare-earth-element composition diagram for 12011 (data from Rhodes et al. 1977, and Nyquist et al. 1979 (highlighted).

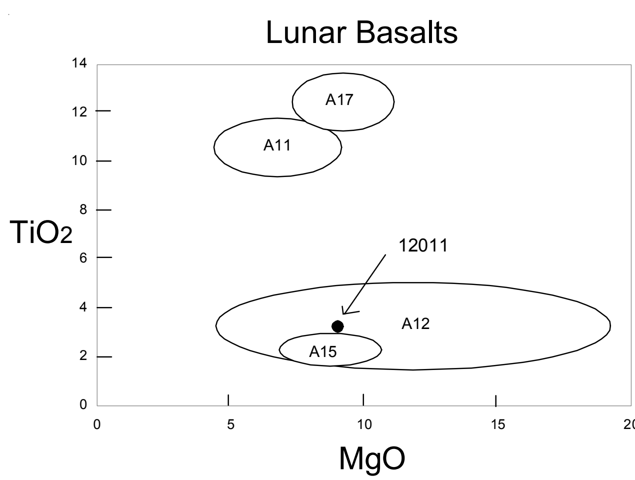

Figure 5: Composition of lunar basalts with 12011 indicated.

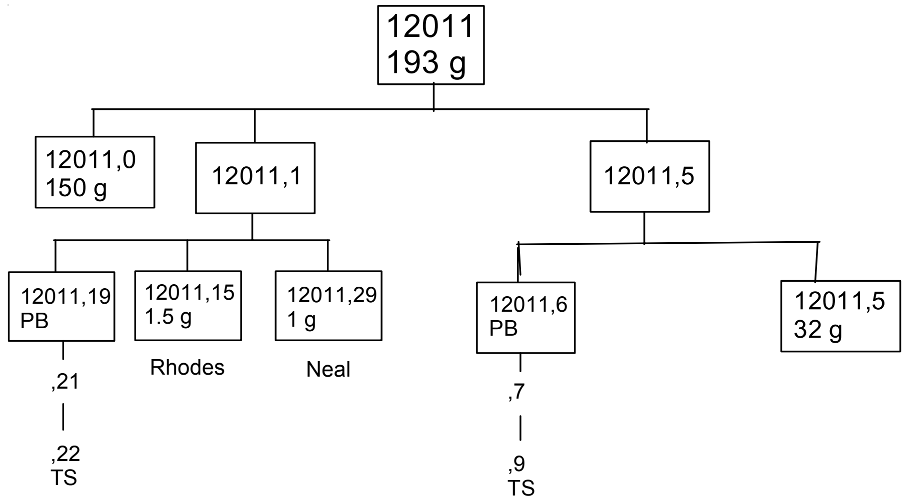

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Table 1. Chemical composition of 12011.

reference	Rhodes77		Baldridge79		Nyquist79		Snyder97		Neal2001	
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)							52	(e)
V									180	(e)
Cr	4050	(a)					2510	(e)	3632	(e)
Co	39	(a)					47.7	(e)		
Ni							30.9	(e)	37	(e)
Cu							14.9	(e)	12.1	(e)
Zn							13.2	(e)	6.8	(e)
Ga							4.2	(e)	3.1	(e)
Ge ppb										
As										
Se										
Rb					1.22	(b)	1.327	(e)	1.18	(e)
Sr	113	(c)			113	(b)	117.9	(e)	114.6	(e)
Y	39	(c)					38.4	(e)	39	(e)
Zr	128	(c)							120	(e)
Nb	7.4	(c)							7.5	(e)
Mo									0.1	(e)
Ru										
Rh										
Pd ppb										
Ag ppb							191	(e)		
Cd ppb										
In ppb										
Sn ppb										
Sb ppb										
Te ppb										
Cs ppm							0.072	(e)	0.06	(e)
Ba	71	(b)			70	(b)	79.1	(e)	73	(e)
La							7.77	(e)	6.84	(e)
Ce	19.9	(a)			18.5	(b)	18.5	(e)	18.5	(e)
Pr							2.79	(e)	2.9	(e)
Nd					14.1	(b)	14.2	(e)	14	(e)
Sm	5	(a)			4.78	(b)	4.8	(e)	4.9	(e)
Eu	0.95	(a)			1	(b)	1.11	(e)	1.01	(e)
Gd					6.47	(b)	5.22	(e)	7.43	(e)
Tb	1.06	(a)					0.94	(e)	1.17	(e)
Dy					7.72	(b)	5.87	(e)	7.77	(e)
Ho							1.32	(e)	1.6	(e)
Er					4.55	(b)	3.73	(e)	4.65	(e)
Tm							0.51	(e)	0.66	(e)
Yb	4.2	(a)			3.93	(b)	3.86	(e)	4.37	(e)
Lu	0.62	(a)			0.548	(b)	0.47	(e)	0.57	(e)
Hf	3.7	(a)							3.69	(e)
Ta									0.46	(e)
W ppb									200	(e)
Re ppb										
Os ppb										
Ir ppb										
Pt ppb										
Au ppb										
Th ppm							0.415	(e)	0.98	(e)
U ppm							0.291	(e)	0.24	(e)

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