

12014
Olivine Basalt
159.4 grams

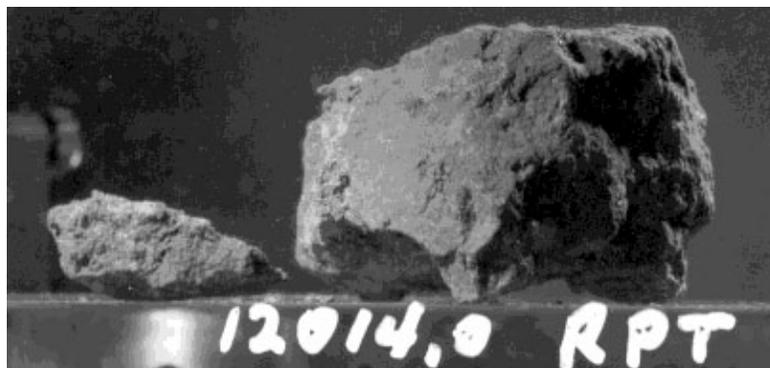


Figure 1: Original “mug shot” of 12014.0. NASA # S69-63385.
Sample is 4 cm.

Introduction

Although 12014 has been analyzed (MgO = 14%) and dated (3.29 ± 0.11 b.y.), it has not been studied petrographically. However, it appears to be an olivine basalt.

Petrography

Rhodes et al. (1977) describe the texture of 12014 as “porphyritic-subophitic” with partially resorbed olivine phenocrysts in a subophitic groundmass (figure 2). Reid (1971) describe it as “olivine-bearing fine-grained acicular to sub-ophitic basalt”. Neal et al. (1994) determined the mode of 12014 and classify it as an olivine basalt based on its chemical composition.

The early crystallization of olivine depletes the composition of the melt in Mg compared to Fe during the crystallization sequence and the compositional variation of early chromites reflects the changing composition of the liquid (Reid 1971).

Mineralogy

Olivine: Olivine is zoned in composition from Fe/(Fe+Mn+Mg) = 0.3 to 0.58 (Reid 1971).

Spinel: Cr-rich spinel was studied by Reid (1971).

Mineralogical Mode for 12014

	Neal et al. 1994
Olivine	24.8
Pyroxene	46.7
Plagioclase	24.5
Ilmenite	0.6
Chromite +Usp	0.7
Mesostasis	2.6
“Silica”	

Chemistry

Rhodes et al. (1977) and Nyquist et al. (1977) determined the chemical composition of 12014 (table 1, figure 5). It is a rather mafic basalt with a relatively flat rare earth element pattern (figure 4).

Radiogenic age dating

Nyquist et al. (1979) determined a Rb-Sr mineral isochron for 12014 with age 3.29 ± 0.11 b.y. (figure 6).

Other Studies

Bogard et al. (1971) reported the content and isotopic composition of rare gases in 12014.

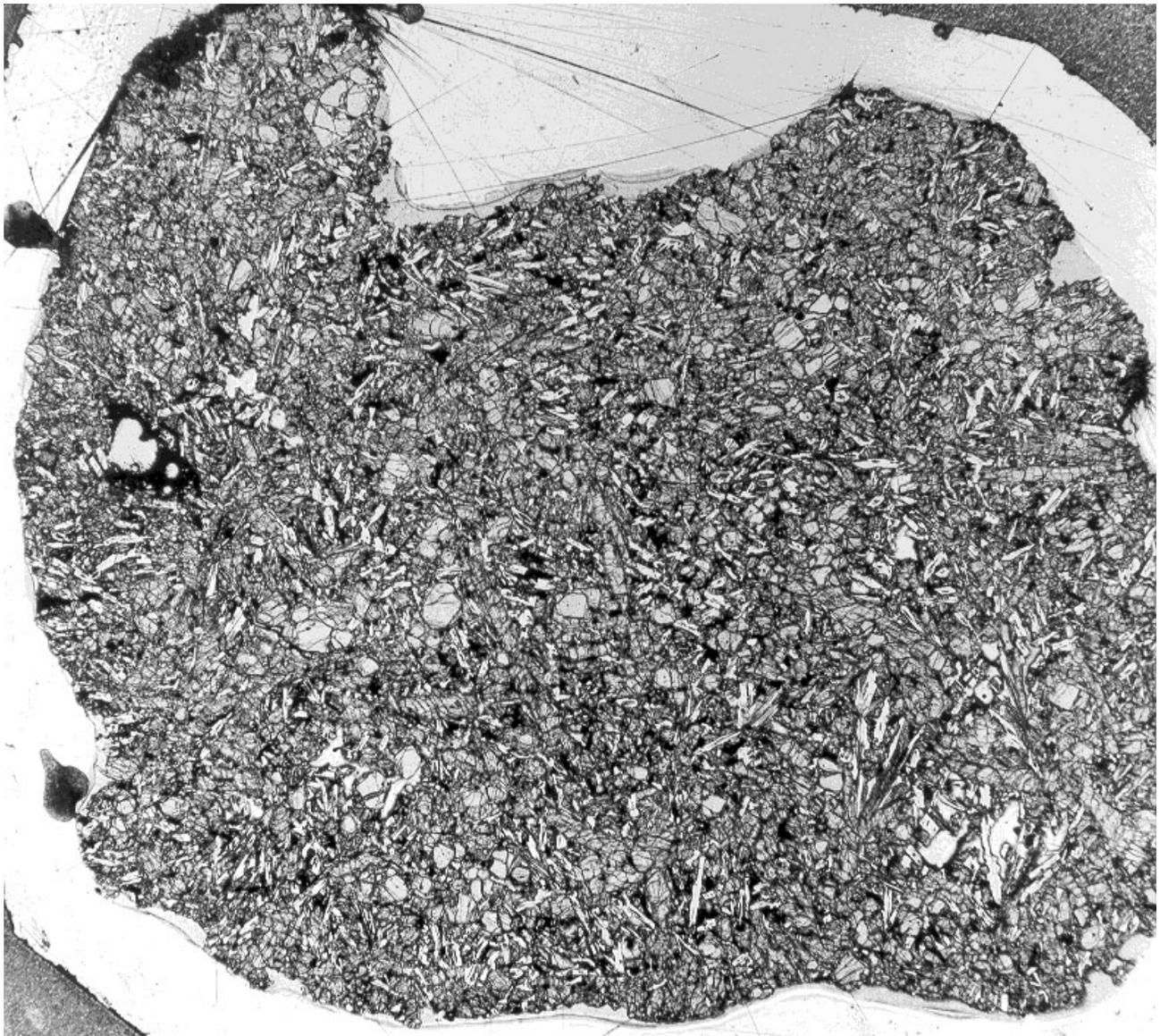


Figure 2: Photomicrograph of thin section 12014,9. NASA photo # S70-25883. Scale = 3 cm.

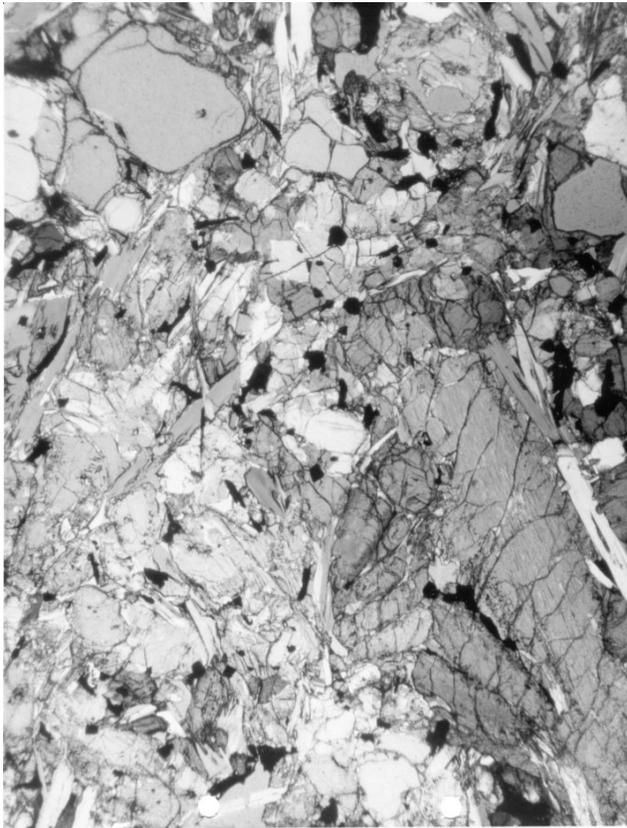


Figure 3: Thin section photomicrograph with partially crossed-nicols, showing olivine and zoned pyroxene phenocrysts. NASA photo# S70-20964. Scale about 2.5 mm.

List of Photo #s for 21014

- S69-63351-359 B & W mug
- S69-63378-385
- S69-64101-102 color
- S69-64126-127
- S70-25883
- S70-25403-404
- S70-49172-179 TS

Summary of Age Data for 12014

	Ar/Ar	Rb/Sr
Nyquist et al. 1979		3.29 ± 0.11 b.y.

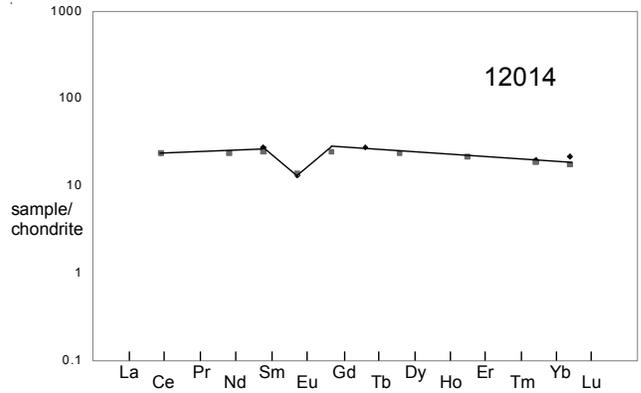


Figure 4: Normalized rare-earth-element diagram for 12014 (data from Nyquist et al. 1977).

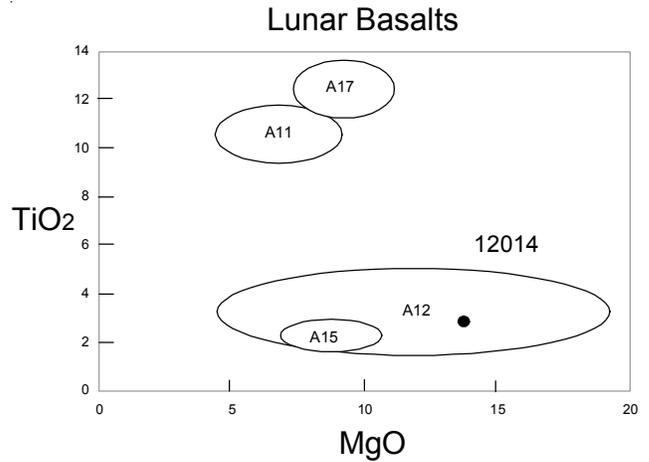


Figure 5: Chemical composition of lunar basalts with 12014 shown.

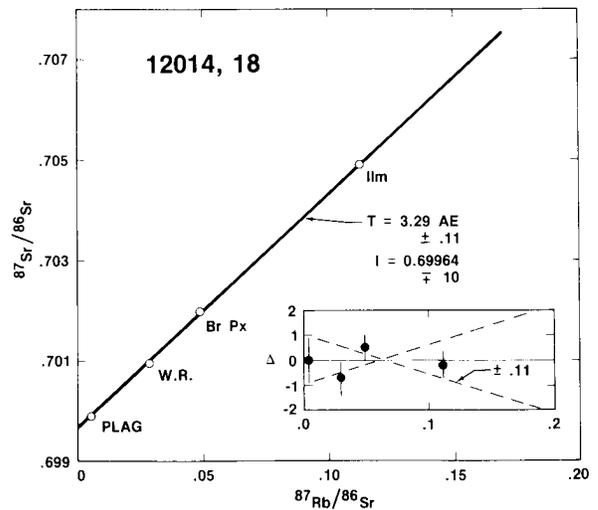


Figure 6: Rb-Sr mineral isochron for 12014 (from Nyquist et al. 1979).

Table 1. Chemical composition of 12014.

reference weight	Rhodes77	Nyquist77 50 mg	Baedecker71	
SiO2 %	45.34	(c)		
TiO2	2.68	(c)		
Al2O3	8	(c)		
FeO	20.33	(c)		
MnO	0.26	(c)		
MgO	13.85	(c)		
CaO	8.63	(c)		
Na2O	0.21	(a)		
K2O	0.06	(c)	0.048	(b)
P2O5	0.05	(c)		
S %	0.07	(c)		
sum				
Sc ppm	42.8	(a)		
V				
Cr	4450	(a)		
Co	54	(a)		
Ni	40	(a)		
Cu				
Zn			1.2	(d)
Ga			2.9	(d)
Ge ppb				
As				
Se				
Rb		0.926	(b)	
Sr	93	(c)	90.4	(b)
Y	32	(c)		
Zr	101	(c)		
Nb	6.8	(c)		
Mo				
Ru				
Rh				
Pd ppb				
Ag ppb				
Cd ppb			2	(d)
In ppb			0.6	(d)
Sn ppb				
Sb ppb				
Te ppb				
Cs ppm				
Ba	53	(b)	53.2	(b)
La				
Ce	14.7	(a)	14.4	(b)
Pr				
Nd			10.9	(b)
Sm	4.14	(a)	3.7	(b)
Eu	0.75	(a)	0.795	(b)
Gd			4.97	(b)
Tb	1.01	(a)		
Dy			5.92	(b)
Ho				
Er			3.56	(b)
Tm				
Yb	3.3	(a)	3.1	(b)
Lu	0.53	(a)	0.433	(b)
Hf	3.3	(a)		
Ta				
W ppb				
Re ppb				
Os ppb				
Ir ppb			0.05	(d)
Pt ppb				
Au ppb				
Th ppm				
U ppm				

technique (a) INAA, (b) IDMS, (c) XRF, (d) RNAA