15682

Pigeonite Basalt

50.6 grams

Figure 1: Photo of 15682 showing micrometeorite craters. Sample is 5 cm across. NASA S71-49893.

Introduction

Lunar sample 15682 was collected by rake about 20 meters from Hadley Rille (Swann et al. 1971). It has a rounded top surface with well preserved micrometeorite craters. It is a typical Apollo 15 pigeonite basalt, and has been dated at 3.44 b.y.

Petrography

Dowty et al. (1973) described 15682 and provided mineral analyses. 15682 has a texture similar to that of 15476 (figure 2 a, b) from Dune Crater. It is a pigeonite basalt; while the other small rake samples from this location were almost all olivine-normative basalts. The pyroxene phenocrysts are skeletal and chemically zoned (figure 3). Spherulitic bundles of plagioclase laths, ilmenite and fine pyroxene crystals occur in the matrix. Metallic Ni-Co-Fe grains, ulvospinel and cristobalite are reported (Ryder 1985).

Lofgren et al. (1975, 1976) and Grove and Walker (1977) studied effects of cooling rate in controlled experiments on synthetic mixtures with the composition of Apollo 15 pigeonite basalts and were able to experimentally reproduce these textures.

Please note that this basalt suffers from extreme iron enrichment at the end stages of crystallization (figure 3). It also suffers from some disfiguring skin disease (figure 1)!

Chemistry

The chemical composition of 15682 has been determined by Hubbard et al. (1973) and Helmke et al. (1973) (figures 4 and 5).

Radiogenic age dating

Papanastassiou and Wasserburg (1973) determined the age by internal Rb/Sr isochron technique (figure 6). Nyquist et al. (1973) also determined the Sr isotope composition.

Processing

There are only 2 thin sections of 15682.

Mineralogical Mode of 15682

	Dowty et al. 1973
Olivine	- -
Pyroxene	62
Plagioclase	22
Opaque	7
Silica	0.6

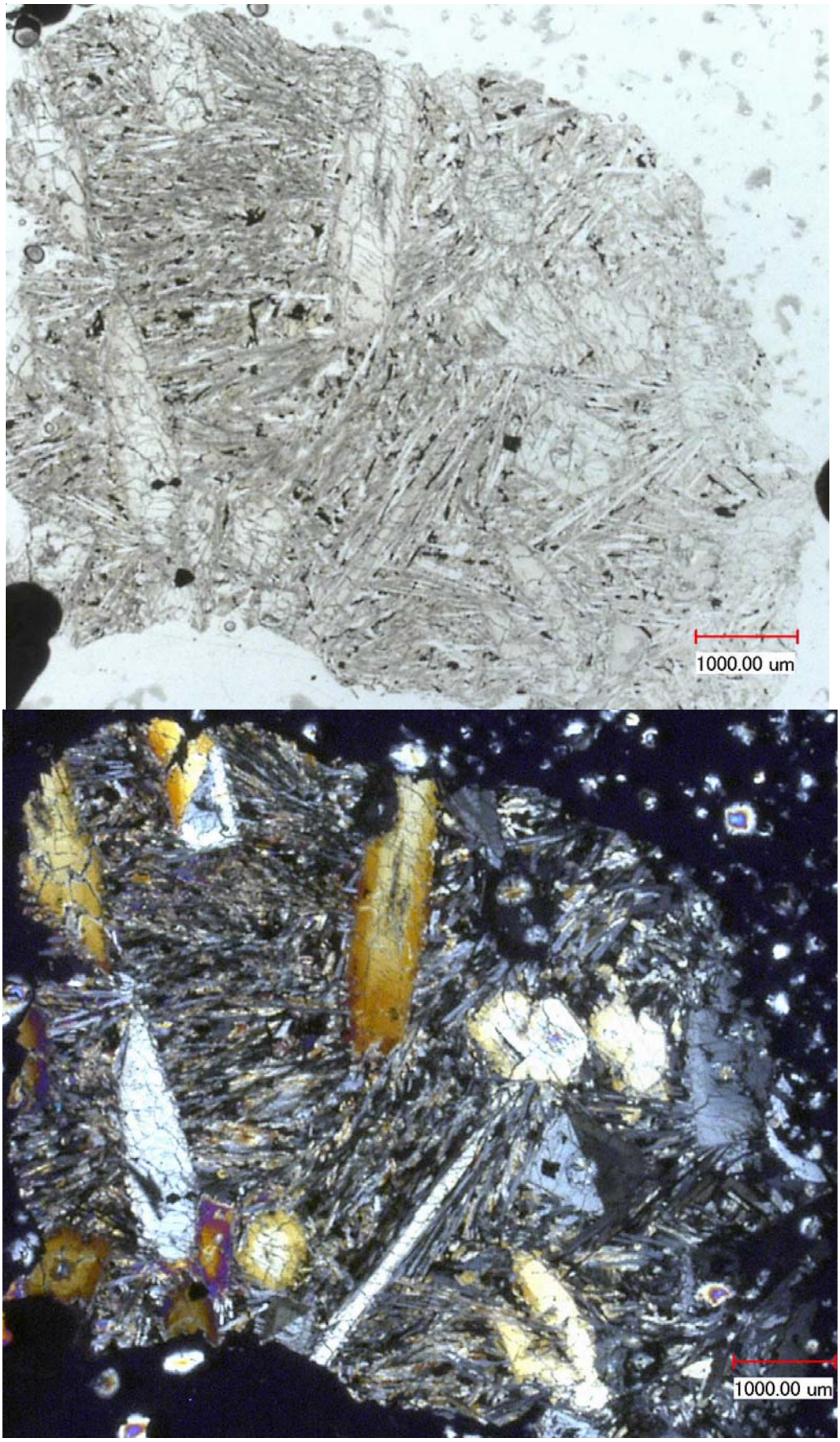


Figure 2: Photomicrographs of thin section 15682,6 by C Meyer @ 30x.

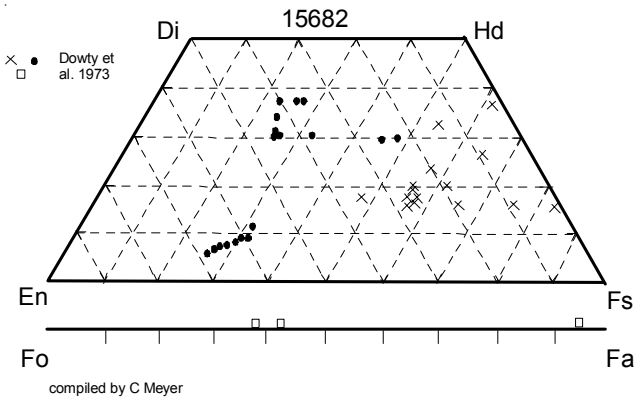


Figure 3: Pyroxene and olivine composition of 15682 (from Dowty et al. 1973).

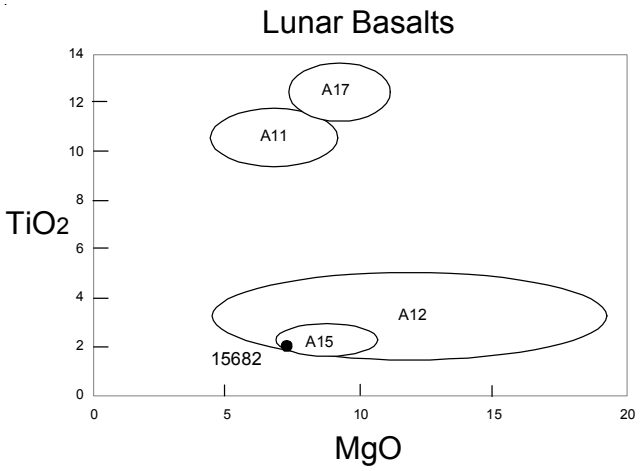


Figure 4: Chemical composition of 15682 compared with that of other lunar basalts.

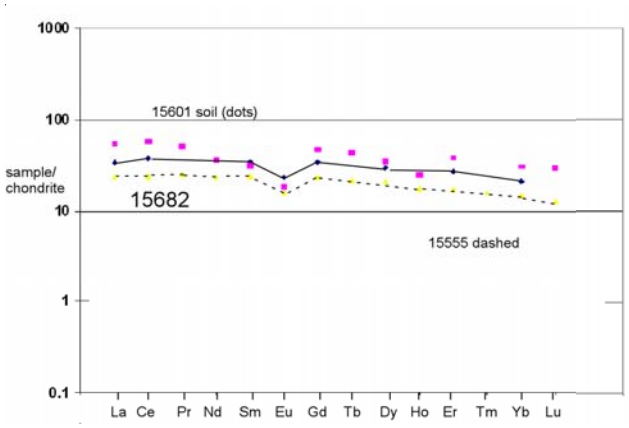


Figure 5: Normalized rare-earth-element diagram for 15682 (data by Rhodes et al. 1973 and Helmke et al. 1973). 15601 and 15555 for comparison.

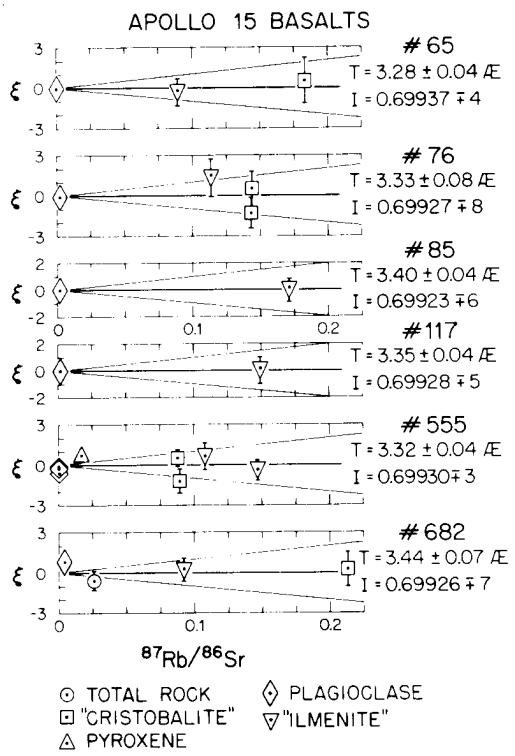


Figure 6: Rb/Sr isochrons for Apollo 15 basalts (from Papanastassiou and Wasserburg 1973).

Summary of Age Data for 15682

	Rb/Sr
Papanastassiou and Wasserburg 1972	3.44 ± 0.07 b.y.

Caution: Old Rb decay constant (1.39).

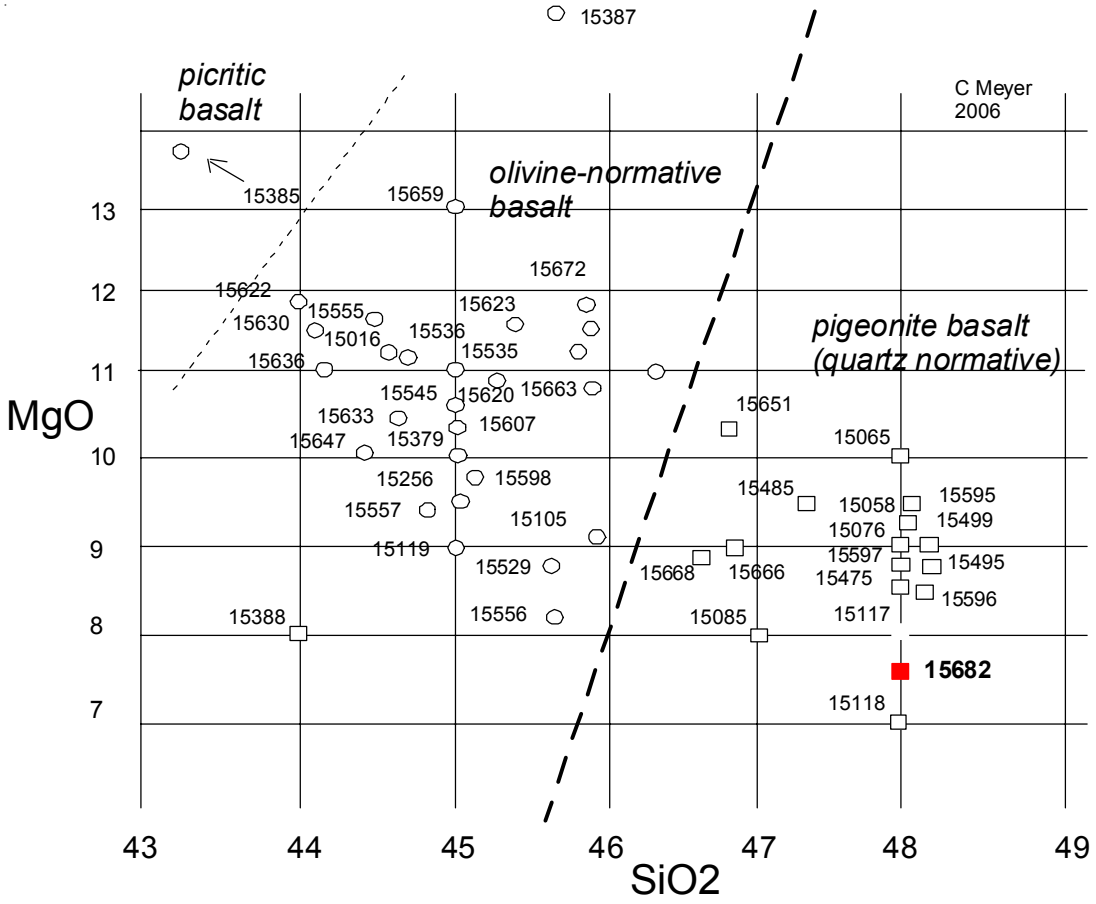


Figure 7: The big picture.

References for 15682

Butler P. (1971) Lunar Sample Catalog, Apollo 15. Curators' Office, MSC 03209

Church S.E., Bansal B.M. and Wiesmann H. (1972) The distribution of K, Ti, Zr, U, and Hf in Apollo 14 and 15 materials. *In* **The Apollo 15 Lunar Samples**, 210-213.

Dowty E., Conrad G.H., Green J.A., Hlava P.F., Keil K., Moore R.B., Nehru C.E. and Prinz M. (1973a) Catalog of Apollo 15 rake samples from stations 2 (St. George), 7 (Spur Crater) and 9a (Hadley Rille). Inst. Meteoritics Spec. Publ. No 11, 51-73. Univ. New Mex. ABQ.

Dowty E., Prinz M. and Keil K. (1973b) Composition, mineralogy, and petrology of 28 mare basalts from Apollo 15 rake samples. *Proc. 4th Lunar Sci. Conf.* 423-444.

Dowty E., Keil K. and Prinz M. (1974c) Lunar pyroxene-phyric basalts: Crystallization under supercooled conditions. *J. Petrology* **15**, 419-453.

Grove T.L. and Walker D. (1977) Cooling histories of Apollo 15 quartz-normative basalts. *Proc. 8th Lunar Sci. Conf.* 1501-1520.

Helmke P.A., Blanchard D.P., Haskin L.A., Telander K., Weiss C. and Jacobs J.W. (1973) Major and trace elements in igneous rocks from Apollo 15. *The Moon* **8**, 129-148.

Hubbard N.J., Rhodes J.M., Gast P.W., Bansal B.M., Shih C.-Y., Wiesmann H. and Nyquist L.E. (1973b) Lunar rock types: The role of plagioclase in non-mare and highland rock types. *Proc. 4th Lunar Sci. Conf.* 1297-1312.

Lofgren G.E., Donaldson C.H. and Usselman T.M. (1975) Geology, petrology and crystallization of Apollo 15 quartz-normative basalts. *Proc. 6th Lunar Sci. Conf.* 79-99.

LSPET (1972a) The Apollo 15 lunar samples: A preliminary description. Science 175, 363-375.

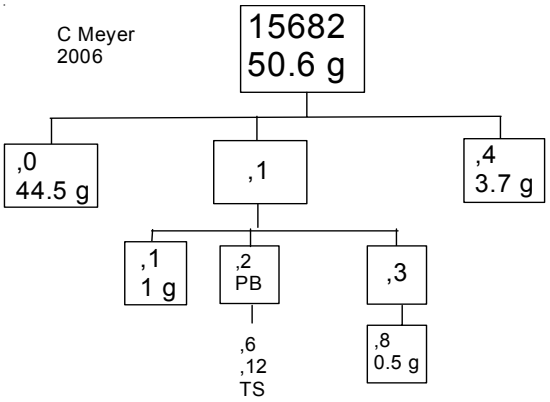
LSPET (1972b) Preliminary examination of lunar samples. Apollo 15 Preliminary Science Report. NASA SP-289, 6-1—6-28.

Nehru C.E., Prinz M., Dowty E. and Keil K. (1974) Spinel-group minerals and ilmenite in Apollo 15 rake samples. *Am. Mineral.* **59**, 1220-1235.

Table 1. Chemical composition of 15682.

reference	Rhodes73		Weismann75 Hubbard73		Dowty73		Helmke73	
weight								
SiO2 %					48	(b)	48.5	(c)
TiO2			2.27	(a)	2.15	(b)	2.13	(c)
Al2O3					10.5	(b)	9.88	(c)
FeO			18.2	(a)	21	(b)	20.6	(c)
MnO					0.26	(b)	0.26	(c)
MgO			7.96	(a)	7.3	(b)	7.17	(c)
CaO					11.3	(b)	10.6	(c)
Na2O			0.34	(a)	0.45	(b)	0.351	(c)
K2O	0.068	(a)			0.09	(b)	0.061	(c)
P2O5					0.08	(b)		
S %								
sum								
Sc ppm							42.7	(c)
V								
Cr							2980	(c)
Co							42	(c)
Ni								
Cu								
Zn								
Ga							3.8	(c)
Ge ppb								
As								
Se								
Rb	1.15	(a)					1.1	(c)
Sr	130	(a)						
Y								
Zr			110	(a)				
Nb								
Mo								
Ru								
Rh								
Pd ppb								
Ag ppb								
Cd ppb								
In ppb								
Sn ppb								
Sb ppb								
Te ppb								
Cs ppm							0.06	(c)
Ba	88.1	(a)						
La	8.04	(a)					6.89	(c)
Ce	22.8	(a)					17.8	(c)
Pr								
Nd	16.3	(a)					13.7	(c)
Sm	5.08	(a)					4.43	(c)
Eu	1.31	(a)					1.1	(c)
Gd	6.8	(a)					6	(c)
Tb							0.95	(c)
Dy	7.26	(a)					6.6	(c)
Ho							1.49	(c)
Er	4.28	(a)					3.8	(c)
Tm								
Yb	3.45	(a)					2.9	(c)
Lu			0.612	(a)			0.41	(c)
Hf			2.9	(a)			2.8	(c)
Ta								
W ppb								
Re ppb								
Os ppb								
Ir ppb								
Pt ppb								
Au ppb								
Th ppm								
U ppm	0.213	(a)						

technique: (a) IDMS, (b) broad beam elec. Probe, (c) mixed AA, INAA, RNAA



Nyquist L.E., Hubbard N.J., Gast P.W., Bansal B.M., Wiesmann H. and Jahn B-M. (1973) Rb-Sr systematics for chemically defined Apollo 15 and 16 materials. *Proc. 4th Lunar Sci. Conf.* 1823-1846.

Papanastassiou D.A. and Wasserburg G.J. (1973) Rb-Sr ages and initial strontium in basalts from Apollo 15. *Earth Planet. Sci. Lett.* **17**, 324-337.

Rhodes J.M. and Hubbard N.J. (1973) Chemistry. classification, and petrogenesis of Apollo 15 mare basalts. *Proc. 4th Lunar Sci. Conf.* 1127-1148.

Ryder G. (1985) Catalog of Apollo 15 Rocks (three volumes). Curatoial Branch Pub. # 72, JSC#20787

Neal C.R. (2001) Interior of the moon: The presence of garnet in the primitive deep lunar mantle. *J. Geophys. Res.* **106**, 27865-27885.

Ryder G. and Schuraytz B.C. (2001) Chemical variations of the large Apollo 15 olivine-normative mare basalt rock samples. *J. Geophys. Res.* **106**, E1, 1435-1451.

Swann G.A., Hait M.H., Schaber G.C., Freeman V.L., Ulrich G.E., Wolfe E.W., Reed V.S. and Sutton R.L. (1971b) Preliminary description of Apollo 15 sample environments. U.S.G.S. Interagency report: 36. pp219 with maps

Swann G.A., Bailey N.G., Batson R.M., Freeman V.L., Hait M.H., Head J.W., Holt H.E., Howard K.A., Irwin J.B., Larson K.B., Muehlberger W.R., Reed V.S., Rennilson J.J., Schaber G.G., Scott D.R., Silver L.T., Sutton R.L., Ulrich G.E., Wilshire H.G. and Wolfe E.W. (1972) 5. Preliminary Geologic Investigation of the Apollo 15 landing site. In Apollo 15 Preliminary Science Rpt. NASA SP-289. pages 5-1-112.

Wiesmann H. and Hubbard N.J. (1975) A compilation of the Lunar Sample Data Generated by the Gast, Nyquist and Hubbard Lunar Sample PI-Ships. Unpublished. JSC