10031

Vitrophyre Basalt

2.7 grams

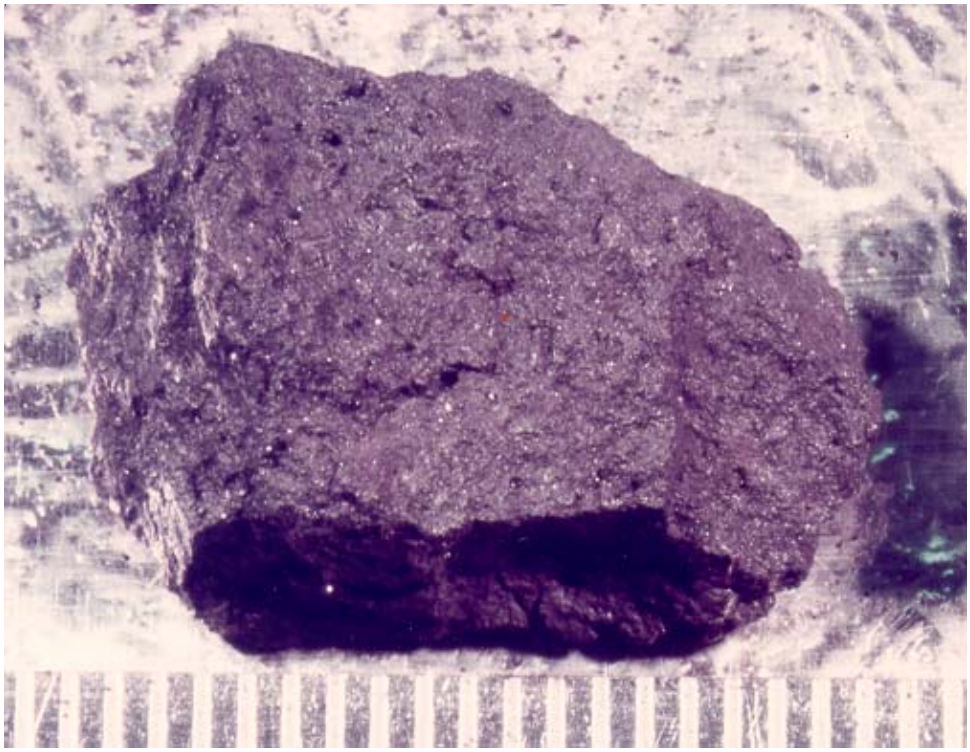

Figure 1: Photo of 10031. Scale 1.8 cm. NASA S76-21144.

Introduction

10031 was returned as a "contingency sample". It is apparently a quickly cooled (quenched) example of the high-K ilmenite basalts from Apollo 11.

It is 3.6 b.y. old and has had an exposure to cosmic rays for ~ 300 m.y.

Petrography

Beaty et al. (1979) describe 10031 as a "vitrophyre". Phenocrysts of olivine and armalcolite (with ilmenite overgrowth) are contained in a fine-grained to glassy groundmass. *"10031 contains about 60% crystals which consist of equant armalcolite mantled by rutile-bearing ilmenite, platey ilmenite (50 x 5 microns) with feathery edges, pyroxene (to 100 microns) and minute troilite spheres. These crystals are enclosed in a brown glass which contains numerous incipient crystallites of ilmenite and pyroxene."(from Beaty et al.)*

Grove and Beaty (1980) were able to reproduce the texture of 10031 experimentally and determine the cooling rate.

Mineralogy

Olivine: Olivine is Fo_{75}.

Pyroxene: Beaty et al. give the composition of some pyroxene grains.

Armalcolite: The composition of armalcolite in 10031 is discussed in Beaty et al.

Ilmenite: Ilmenite in 10031 forms elongate platy grains (figure 2) and also forms overgrowths on armalcolite grains and has exsolution of rutile.

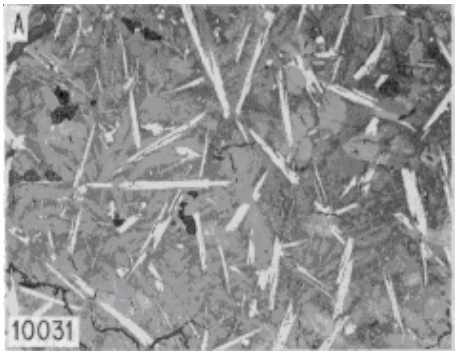

Figure 2: Texture of 10031 from Beaty et al. 1979.

Chemistry

Lunar sample 10031 has the composition typical of the high-K suite of Apollo 11 basalts (table 1).

Radiogenic age dating

Guggisberg et al. (1979) determined the age of 10031 by the Ar/Ar plateau technique (figure 3).

Cosmogenic isotopes and exposure ages

Guggisberg et al. (1979) determined an $^{37}Ar/^{38}Ar$ exposure age of 300 m.y. There are 2 thin sections.

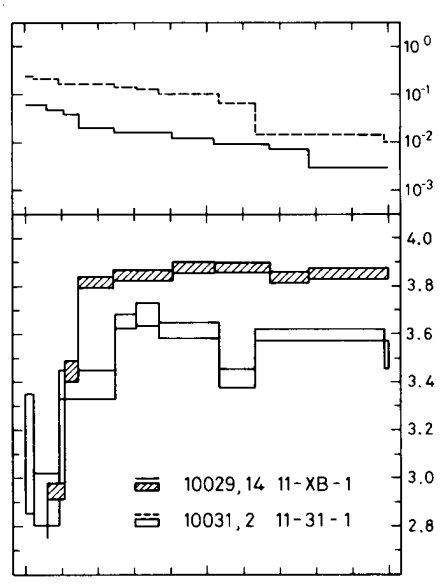

Figure 3: Argon plateau for 10031 compared with 10029 (from Guggisberg et al . 1979).

Summary of Age Data for 10031

	Ar/Ar
Guggisberg et al. 1979	3.6 ± 0.08 b.y. (poorly defined)

Table 1. Chemical composition of 10031.

reference	Beaty 1979	
weight		
SiO2 %		
TiO2	11.4	(a)
Al2O3	8	(a)
FeO	20.7	(a)
MnO	0.225	(a)
MgO	8	(a)
CaO	10.6	(a)
Na2O	0.503	(a)
K2O	0.3	(a)
P2O5		
S %		
sum		
Sc ppm	87	(a)
V	65	(a)
Cr	2370	(a)
Co	28	(a)
Ni		
Cu		
Zn		
Ga		
Ge ppb		
As		
Se		
Rb		
Sr		
Y		
Zr	370	(a)
Nb		
Mo		
Ru		
Rh		
Pd ppb		
Ag ppb		
Cd ppb		
In ppb		
Sn ppb		
Sb ppb		
Te ppb		
Cs ppm		
Ba	330	(a)
La	27.3	(a)
Ce	78	(a)
Pr		
Nd	64	(a)
Sm	20.7	(a)
Eu	2.23	(a)
Gd		
Tb	4.3	(a)
Dy	30	(a)
Ho		
Er		
Tm		
Yb	17.2	(a)
Lu	2.43	(a)
Hf	15.4	(a)
Ta	2.5	(a)
W ppb		
Re ppb		
Os ppb		
Ir ppb		
Pt ppb		
Au ppb		
Th ppm	2.8	(a)
U ppm		

technique: (a) INAA

References for 10031

Beaty D.W., Hill S.M.R., Albee A.L., Ma M.-S., and Schmitt R.A. (1979a) The petrology and chemistry of basaltic fragments from the Apollo 11 soil, part 1. *Proc. 10th Lunar Sci. Conf.* 41-75.

Grove T.L. and Beaty D.W. (1980) Classification, experimental petrology and possible volcanic histories of the Apollo 11 high-K basalts. *Proc. 11th Lunar Planet. Sci. Conf.* 149-177.

Guggisberg S., Eberhardt P., Geiss J., Grogler N., Stettler A., Brown G.M. and Pecket A. (1979) Classification of the Apollo-11 basalts according to Ar^{39}-Ar^{40} ages and petrological properties. *Proc. 10th Lunar Planet. Sci. Conf.* 1-39.

James O.B. and Jackson E.D. (1970) Petrology of the Apollo 11 ilmenite basalts. *J. Geophys. Res.* **75**, 5793-5824.

Kramer F.E., Twedell D.B. and Walton W.J.A. (1977) **Apollo 11 Lunar Sample Information Catalogue** (revised). Curator's Office, JSC 12522

LSPET (1969) Preliminary examination of lunar samples from Apollo 11. *Science* **165**, 1211-1227.

Schmitt H.H., Lofgren G., Swann G.A. and Simmons G. (1970) The Apollo 11 samples: Introduction. *Proc. Apollo 11 Lunar Science Conf.* 1-54.