10005

DRAFT

Drive Tube

53.4 grams

Introduction

Lunar drive tube 10005 was driven into the regolith about 25 cm, but only collected about 10 cm of material (figure 1).

The drive tubes were pressed into the regolith about 12 cm and hammered another 12 cm (Costes and Mitchell 1970). They were only partially filled, because the bit was wider than the tube, which required that the dry uncompressible soil had to "flow" into the tube (the design was changed for later missions). The weight of 10005 given in the catalogs is 65 g (King 1969; Duke and Naugle 1976; Lunar Sourcebook). Apparently 15.5 grams fell out of the cap when this core was first opened (*there is confusion about this*).

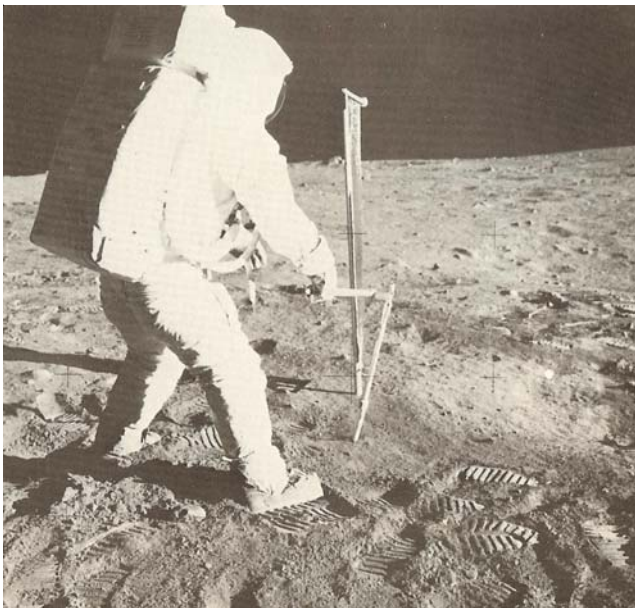

Figure 1: Apollo 11 astronaut tamping in drive tube 10005, near the solar wind experiment. AS11-40-5964

Petrography

The Apollo 11 site was chosen to be flat and as free of rocks as possible. The regolith was found to be uniform over the whole area covered by the Astronauts and the soils all have similar composition.

Fryxell et al. (1970) initially dissected and described the core. A more thorough description was made by Allton (1978). 10005 "displayed a slightly lighter zone approximately 6 cm from the top surface. This zone is 2 to 5 mm thick with a sharp upper boundary and gradational lower boundary" (LSPET 1969a). However, the grain size and material was not different from the dark material.

Grain size distribution (dry sieving) is given in figure 4.

Chemistry

Wakita et al. (1970) reported the chemical composition at five depths along the core (table 1). Note that the average is similar to that of 10084.

Ma et al. (1980) reported the composition of 11 small basalt fragments from 10005 (all high Ti).

Figure 2: Photo of drive tube 10005 after splitting and before dissection in 1977. Scale is in cm. S77-20660.

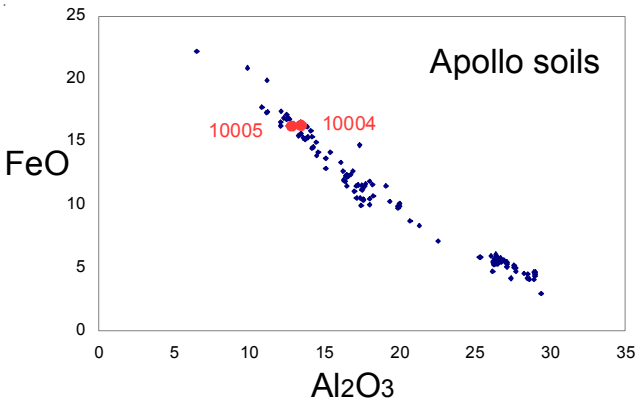

Figure 3: Chemical composition of Apollo 11 soil relative to other Apollo soil samples.

Cosmogenic isotopes and exposure ages

Finkel et al. (1971) found a decrease with depth for 53Mn activity.

Other Studies

Taylor et al. (1971), Oyama et al. (1971) and others conducted numerous investigations looking for organic compounds and/or evidence of any life in the lunar regolith using material from these cores.

Dalymple and Doell (1970) and Hoyt et al. (1970) studied thermoluminescence.

Fleischer et al. (1970), Crozaz et al. (1970) and Lal et al. (1970) studied nuclear tracks in minerals from these cores.

Processing

When the core was initially opened in 1969, about half was allocated to the 'Biopool'. The material that fell out of the cap when the core was opened was also allocated for organic analysis (Oyama et al. 1970). Initial allocations were from 0 cm, 2.6 cm, 5.2 cm, 7.8 cm and 10.5 cm (Allton 1978). Two samples (500 mg each) of 10005 were traded to the Soviet Union - from depths 3 cm and 9 cm - for samples of Luna cores.

The remaining half of drive tube 10005 was described and dissected (Allton 1978). It had apparently been stored upside down (see 10004). Although allocations were made to Morris and McKay, data is not available.

General information on drive tubes is found in another section of this compendium.

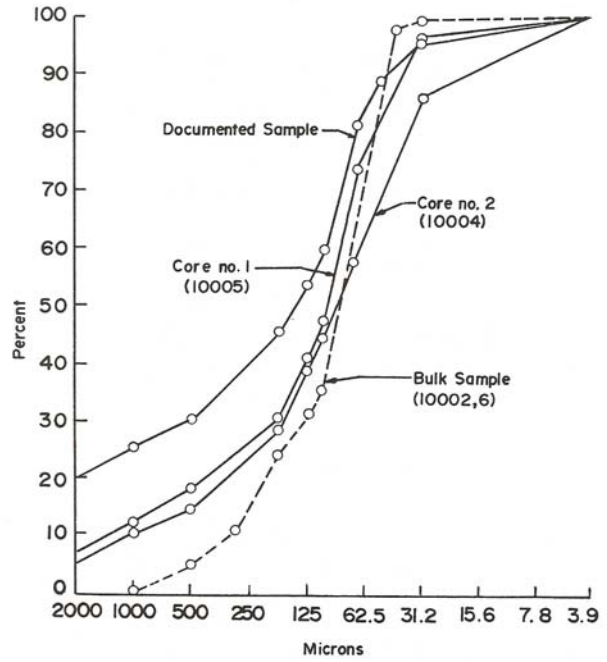

Figure 4: Grain size distribution as reported in initial catalog (King 1969).

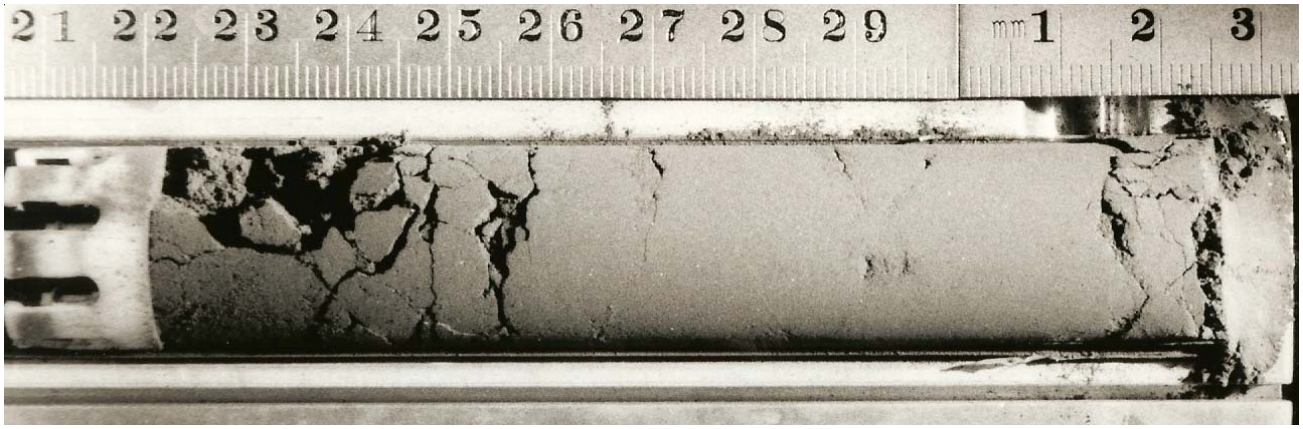

Figure 5: Drive tube 10005 when it was first opened. S69-45049. Scale in cm.

Table 1. Chemical composition of 10005.

	surface	2.6 cm	5.2 cm	7.8 cm	10.5 cm	ave.	
reference	Wakita 70						
weight	82 mg	73	78	131	146		
SiO2 %							
TiO2	8.32	7.84	8.32	7.56	7.67	8	(a)
Al2O3	13.8	13.8	14	14.36	14	14	(a)
FeO	18.14	16.85	17.11	16.34	16.6	17	(a)
MnO	0.21	0.21	0.21	0.2	0.21	0.21	(a)
MgO							
CaO	13.8	11.5	11.8	12.3	12.3	12.3	(a)
Na2O	0.47	0.45	0.42	0.43	0.43	0.44	(a)
K2O							
P2O5							
S %							
sum							
Sc ppm	66	63	62	60	60	62	(a)
V	69	58	80	67	55	66	(a)
Cr	2140	2020	2010	1930	2050	2030	(a)
Co	36	31	31	30	30	32	(a)
Ni							
Cu							
Zn							
Ga							
Ge ppb							
As							
Se							
Rb							
Sr							
Y							
Zr	310	350	280	190	590	340	(a)
Nb							
Mo							
Ru							
Rh							
Pd ppb							
Ag ppb							
Cd ppb							
In ppb							
Sn ppb							
Sb ppb							
Te ppb							
Cs ppm							
Ba	120	160	120	150	140	140	(a)
La	16.6	15.3	15.6	15.3	14.6	15.5	(a)
Ce							
Pr							
Nd							
Sm	12.4	12	12.4	11.4	11.2	11.9	(a)
Eu	2	2.3	2.2	1.8	2	2.1	(a)
Gd							
Tb							
Dy							
Ho							
Er							
Tm							
Yb	11.6	11.6	11.5	10.4	10.5	11.1	(a)
Lu	1.7	1.7	1.6	1.5	1.6	1.6	(a)
Hf	8	8	8	8	7	8	(a)
Ta							
W ppb							
Re ppb							
Os ppb							
Ir ppb							
Pt ppb							
Au ppb							
Th ppm	0.9	1	0.8	0.8	0.7	0.8	(a)
U ppm							

technique: (a) INAA

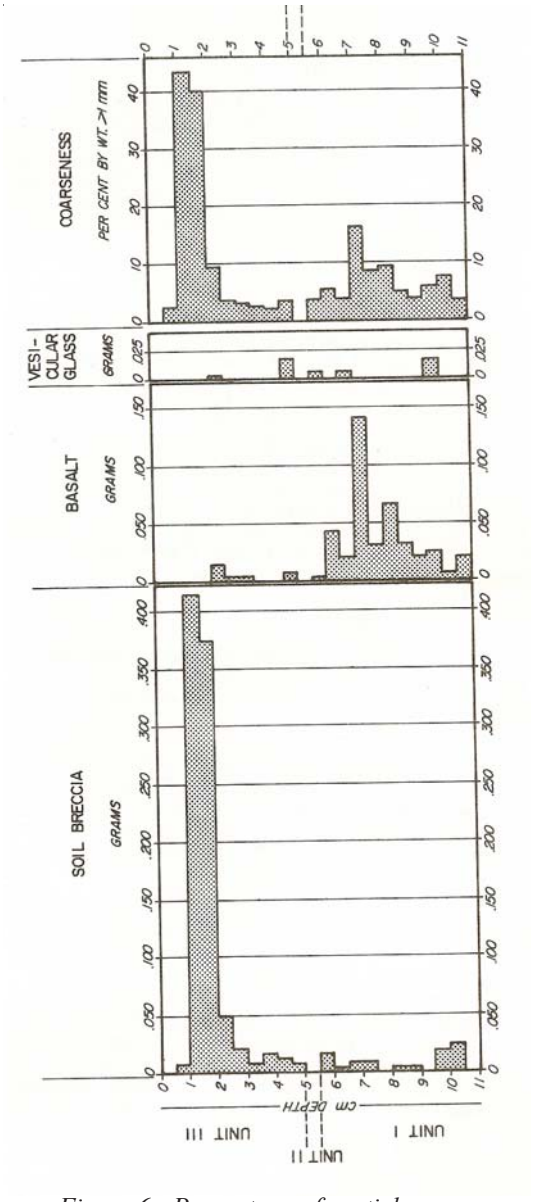

Figure 6: Percentage of particles as funtion of depth in 10005 (Allton 1978).

References for 10005.

Allton J.H. (1978) The Apollo 11 drive tubes. Curatorial facility. NASA Johnson Space Center, Houston.

Beaty D.W. and Albee A.L. (1980) The geology and petrology of the Apollo 11 landing site. *Proc. 11th Lunar Planet. Sci. Conf.* 23-35.

Carrier W.D. (1973) Lunar grain size distribution. *The Moon* **6**, 250-263.

Carrier W.D., Johnson S.W., Werner R.A. and Schmidt R. (1971) Disturbance in samples recovered with the Apollo core tubes. *Proc. 2nd Lunar Science Conf.* 1959-1972.

Carrier W.D., Olhoeft G.R. and Mendell W. (1991) Physical properties of the Lunar Surface. *In* **Lunar Sourcebook: a users guide to the moon**. (eds. Heiken et al.) Cambridge Univ. Press

Costes N.C., Carrier W.D., Mitchell J.K. and Scott R.F. (1969) Apollo 11 soil mechanics investigation. In Apollo 11 Pelim. Sci. Rpt. NASA SP-214, 85-122.

Costes N.C. and Mitchell J.K. (1970) Apollo 11 soil mechanics investigation. *Proc. Apollo 11 Lunar Science Conf.* 2025-2044.

Crozaz G., Haack U., Hair M., Maurette M., Walker R. and Woolum D. (1970) Nuclear track studies of ancient solar radiations and dynamic lunar surface processes. *Proc. Apollo 11 Lunar Science Conf.* 2051-2080.

Dalrymple G.B. and Doell R.R. (1970) Thermoluminescence of lunar samples from Apollo 11. *Proc. Apollo 11 Lunar Science Conf.* 2081-2092.

Duke M.B. and Nagle J.S. (1976) Lunar Core Catalog. JSC09252 rev. Curators' Office

Finkel R.C., Arnold J.R., Imamura M., Reedy R.C., Fruchter J.S., Loosli H.H., Evans J.C., Delany A.C. and Shedlovsky J.P. (1971) Depth variation of cosmogenic nuclides in a lunar surface rock and lunar fines. *Proc. 2nd Lunar Sci. Conf.* 1773-1789.

Fleischer R.L., Haines E.L., Hart H.R., Wood R.T. and Comstock G.M. (1970) The particle track record of the Sea of Tranquillity. *Proc. Apollo 11 Lunar Science Conference* 2103-2120.

Fryxell R., Anderson D., Carrier D., Greenwood W. and Heiken G. (1970) Apollo 11 drive-tube core samples: an initial physical analysis of lunar surface sediment. *Proc. Apollo 11 Lunar Science. Conf.* 2121-2126.

Hoyt H.P., Kardos J.L., Miyajima M., Seitz M.G., Sun S.S., Walker R.M. and Wittels M.C. (1970) Thermoluminescence, X-ray and stored energy measurements of Apollo 11 samples. *Proc. Apollo 11 Lunar Science Conf.* 2269-2287.

King E.A. *and a cast of thousands* (1969) Lunar Sample Information Catalog, Apollo 11. Lunar Receiving Laboratory, MSC 412 pp

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

Lal D., Macdougall D., Wilkening L. and Arrhenius G. (1970) Mixing of the lunar regolith and cosmic ray spectra: Evidence from particle-track studies. *Proc. Apollo 11 Lunar Science Conf.* 2295-2303.

LSPET (1969a) Preliminary examination of lunar samples. In Apollo 11 Prelim. Sci. Rpt. NASA SP-214. 123-142

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

Ma M.-S., Schmitt R.A., Beaty D.W. and Albee A.L. (1980) The petrology and chemistry of basaltic fragments from the Apollo 11 soil: Drive tubes 10004 and 10005. *Proc. 11th Lunar Planet. Sci. Conf.* 37-47.

Oyama V.J., Merek E.L., Silverman M.P. and Boylen C.W. (1971) Search for viable organisms in lunar samples: Further biological studies of Apollo 11 core, Apollo 12 bulk, and Apollo 12 core samples. *Proc. 2nd Lunar Sci. Conf.* 1931-1937.

Taylor G.P., Ellis W., Johnson P.H., Kropp K. and Groves T. (1971) Microbial assay of lunar samples. *Proc. 2nd Lunar Science Conf.* 1939-1948.

Wakita H., Schmitt R.A. and Rey P. (1970) Elemental abundances of major, minor, and trace elements in Apollo

11 lunar rocks, soil, and core samples. *Proc. Apollo 11 Lunar Sci. Conf.* 1685-1717.