68501 and 68510

Soil and rake residue

906 and 17 grams

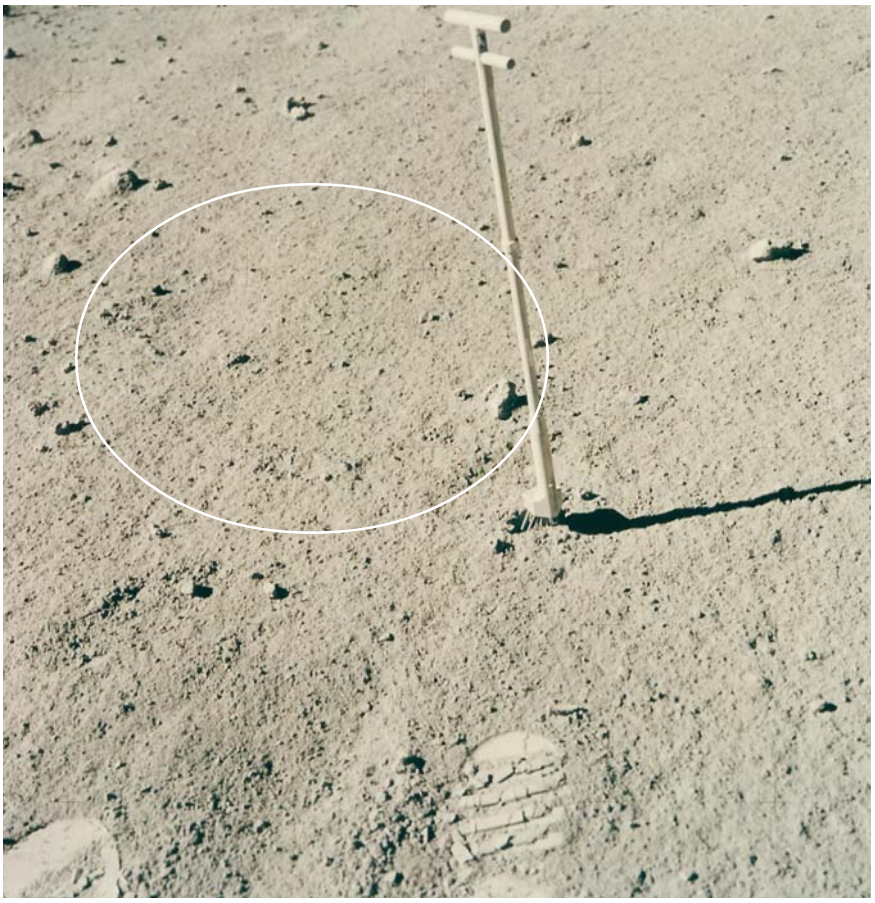


Figure 1: Close-up photo of area where 68500 and 68510 were collected. AS16-107-17528.

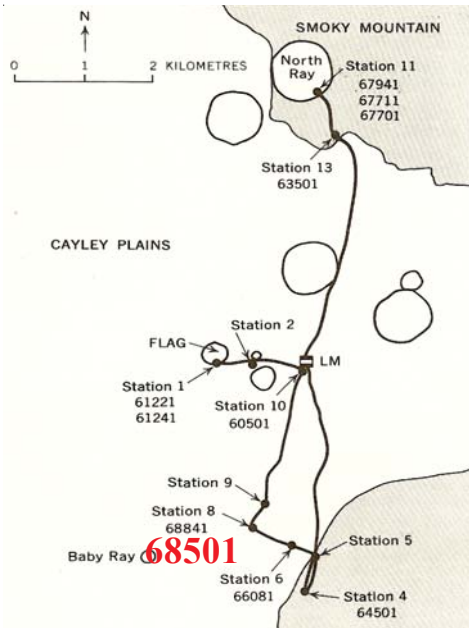


Figure 2: Map of Apollo 16 site.

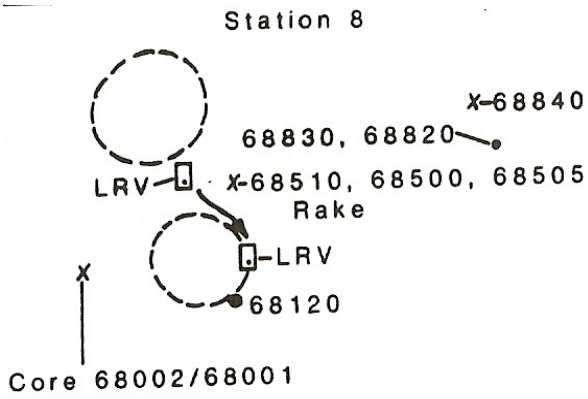


Figure 3: Map of station 8, Apollo 16.

Introduction

Station 8 was supposed to be on a ray from South Ray Crater, but material from SRC has not been identified as such.

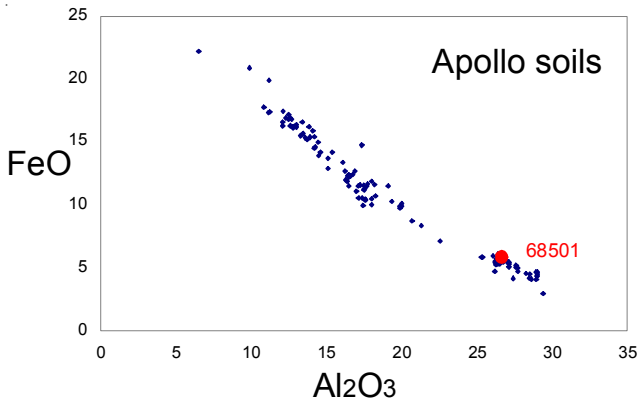


Figure 4: Composition of 68501 compared with other Apollo soil samples.

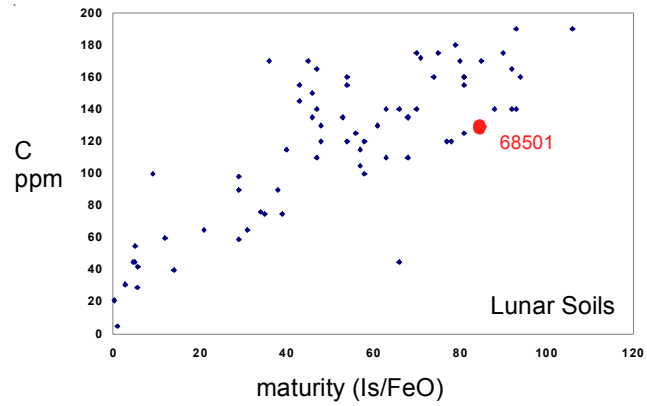


Figure 5: Carbon content and maturity index for 68501 and other Apollo soil samples.

Petrography

The maturity index for 68501 is I_s/FeO = 85, with agglutinate content of about 38 %. The average grain size is 84 microns, 104 microns or 113 microns (Heiken, vonEngelhardt or Butler)(figures 7).

The mode for 68501 is given in Heiken et al. (1973) and Houck (1982).

Smith and Steele (1972) cataloged the rake samples from 68510 and Marvin (1972) cataloged the coarse fine particles.

Chemistry

Bansal et al. (1972), Taylor et al. (1973) and Korotev (1981) determined the chemical composition of 68501 (table 1, figure 4 and 6).

Moore et al. (1973) and des Marais et al. (1973) determined 130 ppm and 82 ppm carbon for 68501 (figure), respectively. Kerridge et al. (1975) determined 134 ppm carbon and 83 ppm nitrogen.

Cosmogenic isotopes and exposure ages

Eldridge et al. (1973) determined the cosmic-ray-induced activity of ^{26}Al = 84 dpm/kg and ^{22}Na = 38 dpm/kg.

Other Studies

Hintenberger and Weber (1973) determined the rare gas content and isotopic ratios for 68501 as a function of grain size showing surface correlation.

Behrmann et al. (1973) determined the density of fossil nuclear tracks in grains from 68501 (figure 8).

Mineralogical Mode for 68501

	Heiken et al. 1973	Houck 1982
Agglutinate	38 %	36.7
Breccia	38.5	39.8
Anorthosite	2.5	1.3
Olivine		
Pyroxene	1.6	2.9
Plagioclase	12.3	13.5
Opaques		0.1
Glass	4.9	5.5
Basalt	0.3	0.3

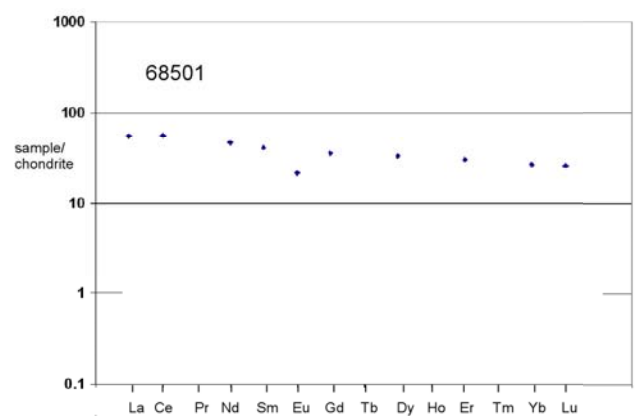
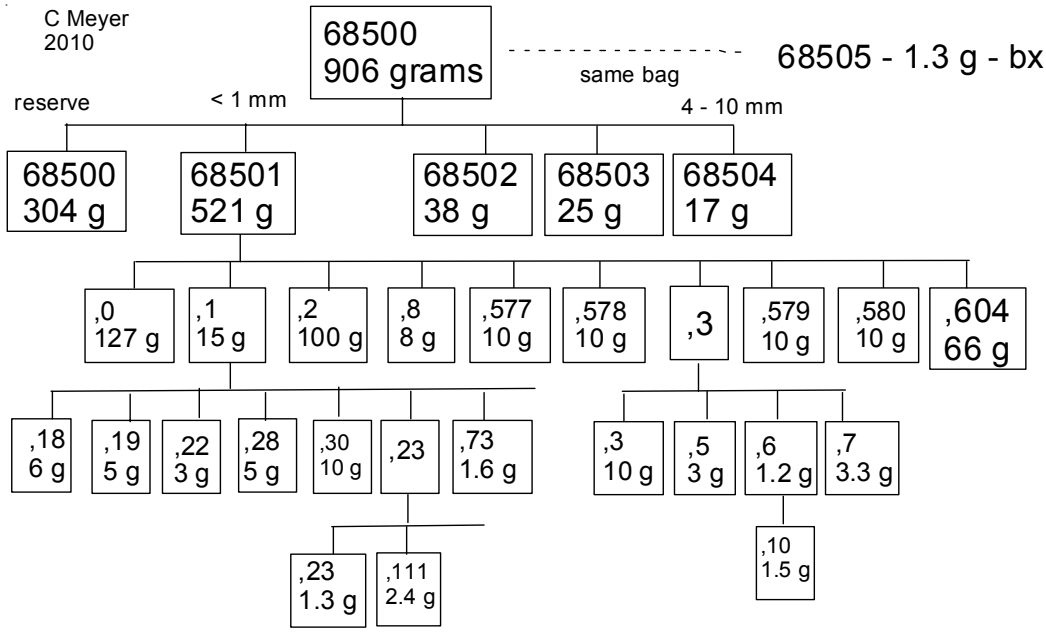
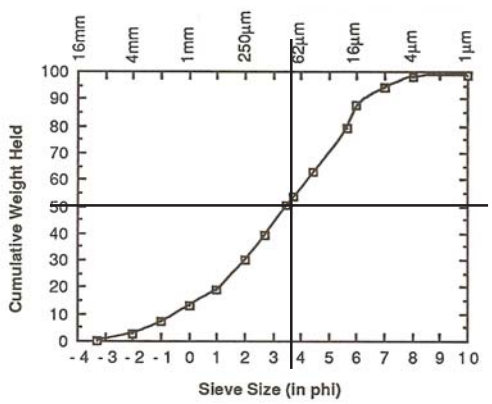


Figure 6: Normalized rare-earth-element diagram for 68501.





average grain size = 104 microns

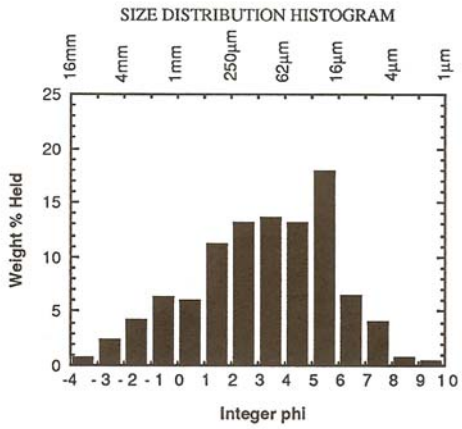
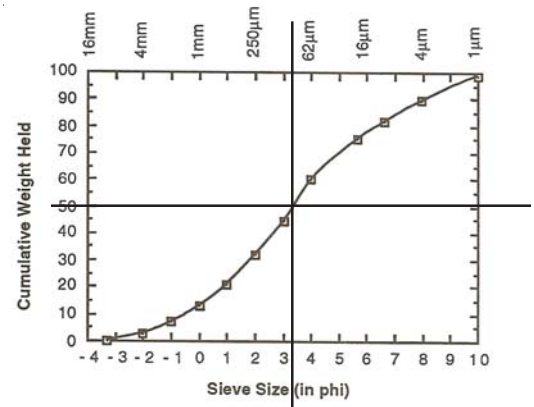


Figure 7a: Grain size distribution for 68501 (Graf 1993, data by Heiken et al.).



average grain size = 84 microns

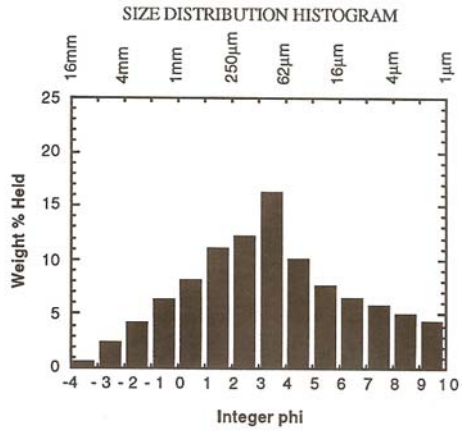
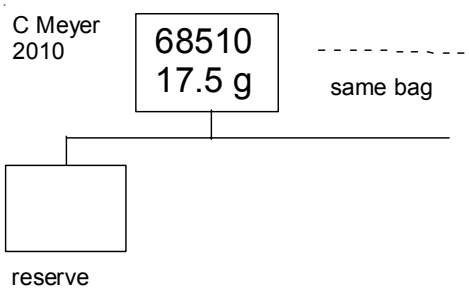


Figure 7b: Grain size distribution for 68501 (Graf 1993, data by vonEngelhardt).



68515 - 336 g - bx
68516 - 34 g
68517 - 13 g
68518 - 30 g
68519 - 10.6 g
68525 - 39 g
68526
68527
68528
68529
68535
68536
68537

References for 68501.

Bansal B.M., Church S.E., Gast P.W., Hubbard N.J., Rhodes J.M. and Weismann H. (1972) The chemical composition of soil from the Apollo 16 and Luna 20 sites. *Earth Planet. Sci. Lett.* **17**, 29-35.

Butler P. (1972) Lunar Sample Information Catalog Apollo 16. Lunar Receiving Laboratory. MSC 03210 Curator's Catalog. pp. 370.

Butler J.C., Greene G.M. and King E.A. (1973) Grain size frequency distribution and modal analysis of Apollo 16 fines. *Proc. 4th Lunar Sci. Conf.* 267-278.

Des Marais D.J., Hayes J.M. and Meinschein W.G. (1973a) The distribution in lunar soils of carbon released by pyrolysis. *Proc. 4th Lunar Sci. Conf.* 1543-1558.

Eldridge J.S., O'Kelley G.D. and Northcutt K.J. (1973) Radionuclide concentrations in Apollo 16 lunar samples

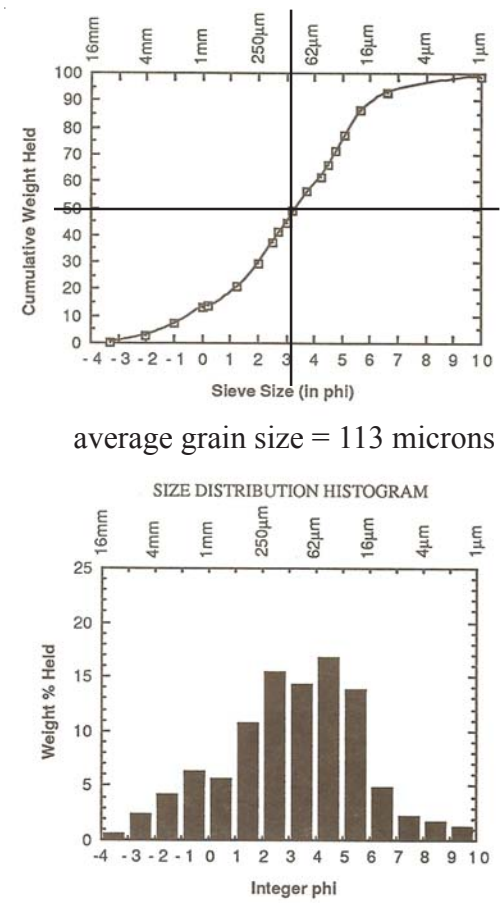


Figure 7c: Grain size distrbution for 68501 (Graf 1993, data from Butler et al. 1973).

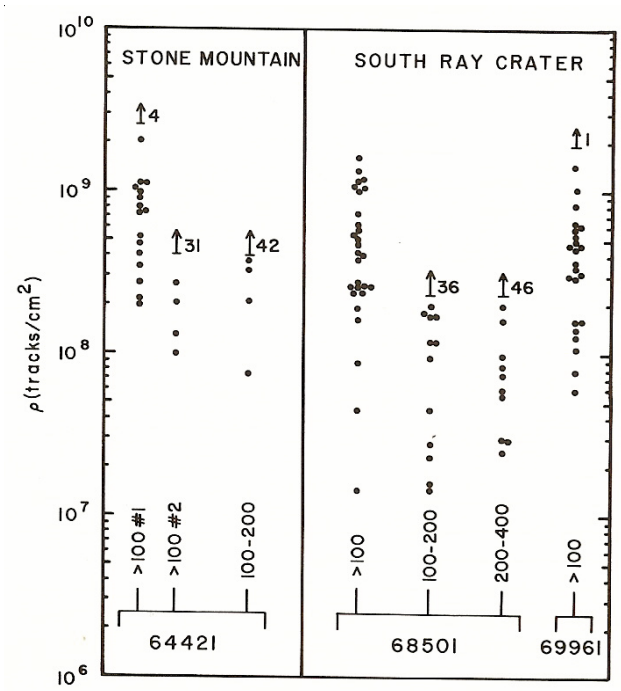


Figure 8: Density of nuclear tracks etched in grains from Apollo 16 soils (Behrmann et al. 1973).

Table 1. Chemical composition of 68501.

								Hubbard73			ave st. 8
reference	Korotev81			Taylor73		Eldridge73		Bansal72			Korotev81
weight	C	F						Wiesmann76			
SiO2 %				44.9	(b)			45.2	(d)		45.1
TiO2				0.56	(b)			0.58	(d)		0.56
Al2O3				26.9	(b)			26.65	(d)		26.6
FeO	5.57	5.34	(a)	5.32	(b)			5.48	(d)		5.35
MnO											0.07
MgO				6.27	(b)			6.28	(d)		6.3
CaO				15.1	(b)			15.36	(d)		15.3
Na2O	0.491	0.48	(a)	0.36	(b)			0.47	(d)		0.46
K2O				0.16	(b)	0.116	(c)	0.116	(e)		0.121
P2O5								0.12			
S %								0.08			
sum											
Sc ppm	9.2	9.2	(a)	10	(b)						9.6
V				27	(b)						14
Cr	795	905	(a)	850	(b)			737	(e)		760
Co	34.7	22.6	(a)	34	(b)						30
Ni	560	375	(a)	420	(b)						490
Cu				4.5	(b)						
Zn											
Ga											
Ge ppb											
As											
Se											
Rb				2.3	(b)			2.7	(e)		2.7
Sr								169	(e)		158
Y				49	(b)						48
Zr				220	(b)			185	(e)		194
Nb				14.9	(b)						
Mo											
Ru											
Rh											
Pd ppb											
Ag ppb											
Cd ppb											
In ppb											
Sn ppb											
Sb ppb											
Te ppb											
Cs ppm				0.09	(b)						
Ba				185	(b)			140	(e)		147
La	13.6	14.4	(a)	15.7	(b)			12.9	(e)		13.4
Ce	35.5	36.5	(a)	41.5	(b)			33.6	(e)		34
Pr				5.54	(b)						
Nd				21.6	(b)			20.9	(e)		
Sm	6.2	6.45	(a)	6.32	(b)			5.96	(e)		6.55
Eu	1.2	1.19	(a)	1.29	(b)			1.19	(e)		1.25
Gd				7.57	(b)			7	(e)		
Tb	1.28	1.28	(a)	1.23	(b)						1.27
Dy				8.35	(b)			7.99	(e)		
Ho				1.92	(b)						
Er				5.45	(b)			4.71	(e)		
Tm				0.75	(b)						
Yb	4.4	4.45	(a)	4.95	(b)			4.27	(e)		4.65
Lu	0.62	0.62	(a)	0.73	(b)			0.621	(e)		0.67
Hf	4.5	4.5	(a)	4	(b)						4.5
Ta	0.8	0.8	(a)								0.6
W ppb											
Re ppb											
Os ppb											
Ir ppb											
Pt ppb											
Au ppb											
Th ppm	2.4	2.3	(a)	2.45	(b)	2.28	(c)				2.4
U ppm				0.63	(b)	0.58	(c)	0.6	(e)		0.62

technique: (a) INAA, (b) SSMS, (c) radiation count. (d) XRF, (e) IDMS

determined by nondestructive gamma-ray spectrometry. *Proc. 4th Lunar Sci. Conf.* 2115-2122.

von Engelhardt W., Hurrle H. and Luft E. (1976) Microimpact-induced changes of textural parameters and modal composition of the lunar regolith. *Proc. 7th Lunar Sci. Conf.* 373-392.

Graf J.C. (1993) Lunar Soils Grain Size Catalog. NASA Pub. 1265

Heiken G.H., McKay D.S. and Fruland R.M. (1973b) Apollo 16 soils – grain size analysis and petrography. *Proc. 4th Lunar Sci. Conf.* 251-266.

Hintenberger H. and Weber H.W. (1973) Trapped rare gases in lunar fines and breccias. P*roc. 4th Lunar Sci. Conf.* 2003-2019.

Houck K.J. (1982a) Petrologic variations in Apollo 16 surface soils. *Proc. 13th Lunar Planet. Sci. Conf.* J. Geophys. Res. **87**, A197-A209.

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.

Janghorbani M., Miller M.D., Ma M-S., Chyi L.L. and Ehmann W.D. (1973) Oxygen and other elemental abundance data for Apollo 14, 15, 16 and 17 samples. *Proc. 4th Lunar Sci. Conf.* 1115-1126.

Jovanovic S. and Reed G.W. (1973b) Volatile trace elements and the characterization of the Cayley formation and the primitive lunar crust. *Proc. 4th Lunar Sci. Conf.* 1313-1324.

Kerridge J.F., Kaplan I.R., Petrowski C. and Chang S. (1975) Light element geochemistry of Apollo 16 rocks and soils. *Geochim. Cosmochim. Acta* **39**, 137-162.

LSPET (1973) The Apollo 16 lunar samples: Petrographic and chemical description. *Science* 179, 23-34.

LSPET (1972) Preliminary examination of lunar samples. Apollo 16 Preliminary Science Report. NASA SP-315, 7-1—7-58.

Marvin U.B. (1972) Apollo 16 coarse fines (4-10 mm): Sample classification, description and inventory. JSC Catalog.

Moore C.B., Lewis C.F. and Gibson E.K. (1973) Total carbon contents of Apollo 15 and 16 lunar samples. *Proc. 4th Lunar Sci. Conf.* 1613-1923.

Moore C.B. and Lewis C.F. (1975) Total nitrogen contents of Apollo 15, 16 and 17 lunar fines samples. *Lunar Sci.* **VI**, 569-571.

Morris R.V., Score R., Dardano C. and Heiken G. (1983) Handbook of Lunar Soils. Two Parts. JSC 19069. Curator's Office, Houston

Morris R.V. (1978) The surface exposure (maturity) of lunar soils: Some concepts and Is/FeO compilation. *Proc. 9th Lunar Sci. Conf.* 2287-2297.

Nunes P.D., Tatsumoto M., Knight R.J., Unruh D.M. and Doe B.R. (1973b) U-Th-Pb systematics of some Apollo 16 lunar samples. *Proc. 4th Lunar Sci. Conf.* 1797-1822.

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.

Papike J.J., Simon S.B. and Laul J.C. (1982) The lunar regolith. *Rev. Geophys. Space Phys.* 20, 761-826.

Smith J.V. and Steele I.M. (1972) Apollo 16 rake samples 67515 to 68537: Sample classification, description and inventory. Curator's Catalog. JSC

Sutton R.L. (1981) Documentation of Apollo 16 samples. In Geology of the Apollo 16 area, central lunar highlands. (Ulrich et al.) U.S.G.S. Prof. Paper 1048.

Taylor S.R., Gorton M.P., Muir P., Nance W.B., Rudowski R. and Ware N. (1973a) Composition of the Descartes region, lunar highlands. *Geochim. Cosmochim Acta* **37**, 2665-2683.

Tera F. and Wasserburg G.J. (1972b) U-Th-Pb systematics in the lunar highland samples from the Luna 20 and Apollo 16 missions. *Earth Planet. Sci. Lett.* **17**, 36-51.