14210 - 14211

Double Drive Tube

169.7 + 39.5 grams

32.5 + 7.5 cm

Introduction

A double drive tube (2 cm) was collected at Station A, about 200 meters from the LM (Mitchell et al. 1971). The bottom segment (14210) was full, but the top (14211) only contained 39.5 grams. Altogether the core is about 40.5 cm long. According the the transcript the lunar regolith was smooth where the core was taken.

Carrier et al. (1972) reported that the double drive tube was pushed in about 13 cm and driven to 64 cm. Some of the core material fell out, during extraction and decoupling. Crozaz (1980) states that this material was lost from the join between the cores in which case the lower portion is from a greater depth than described herin. But this is the best core from the Apollo 14 regolith.

Petrography

Morris and Lauer (1980) determined the maturity as a function of depth (figure 1), finding that the entire core was homogeneous. Nagle (1979) found color and grain size variations as function of depth and recorded observations made during dissection (figure 2). *"The upper 12.5 cm contains dark, fine-grained soil which carries an abundance of soil breccias and dark, vesicular glass; it can be subdivied into three units on the basis of texture. The lowest 23.2 cm of the core is light-colored, moderately fine to fine-grained soil which is rich in mineral grains, annealed-matix breccia fragments and tan ropy glass; it can also be subdivided into three uints. Between 12.5 and 14.5 cm lies the zone of demarcation between the upper dark soil and the lower ligh soil; it is an extremely coarse-sized concentraiton of dark vesicualr glass which grades downward into progressively more friable soil breccia".*

Simon et al. (1982) studied the petrology of the core using the continuous set of thin sections (figure 3) and although they did not find "major variations as function of depth", they reported significant variation in modal grain counts of different lithologies (table). Papike et al. (1982) provide an excellent summary.

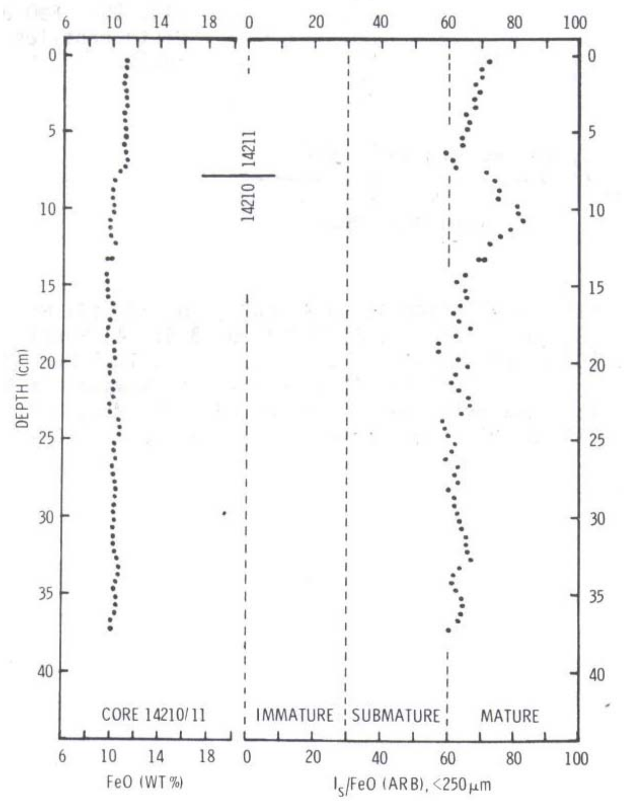

Figure 1: Maturity along double drive tube 14211 - 14210 (Morris and Lauer 1980).

Chemistry

Laul et al. (1982) determined the chemical composition of 14211 – 14210 as fuction of depth and found it to be homogeneous and similar to the other soils and cores at Apollo 14 (table 1, figures).

Jovanovic and Reed (1979) studied the variation of Hg and Br as function of depth in the top section of this core (figure 8).

Other Studies

Crozaz (1980) determined the fossil track density finding a striking variation with depth that is inconsistent with observations of Nagle (1979), Simon (1982) and the maturity (figure 5).

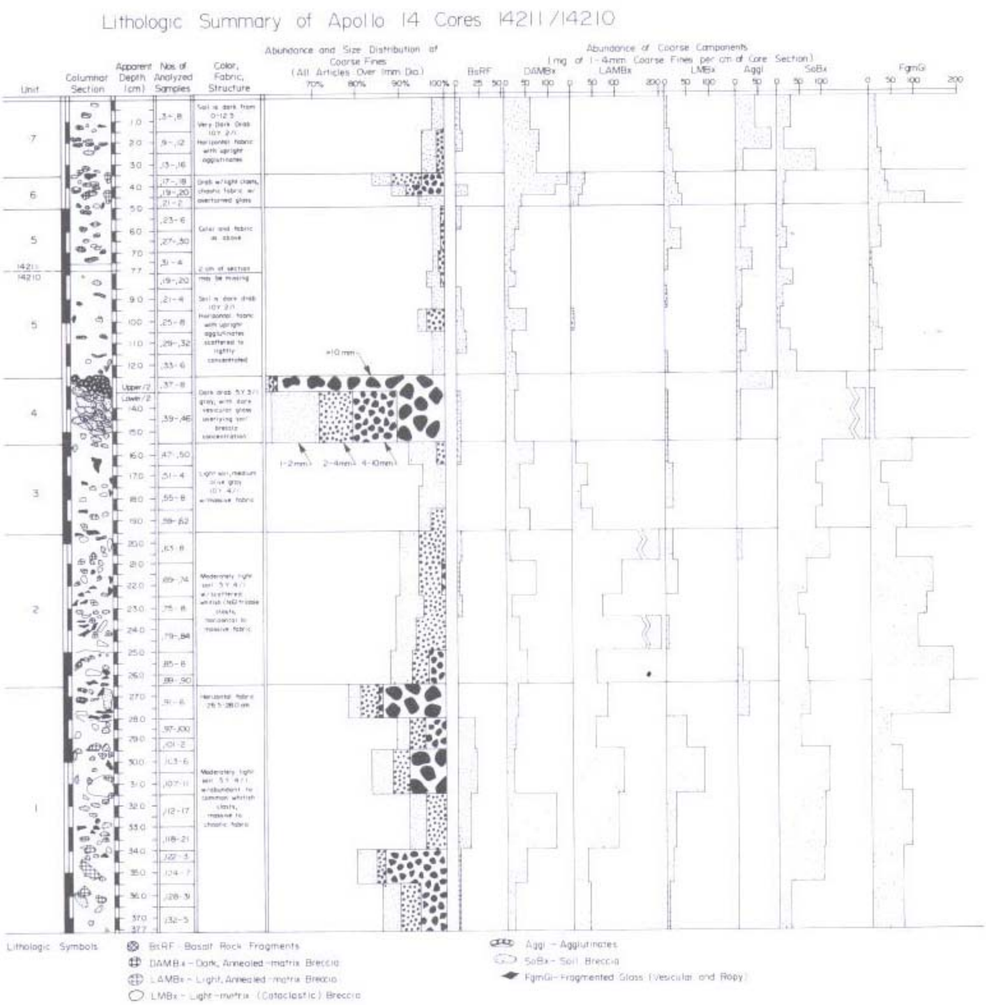

Figure 2: Stu Nagle's interpretation of the double drive tube 14211 - 14210 based on observations made during core dissection (Nagle 1979a).

Processing

14211 – 14210 was milled open lenghtwise and dissections were made every 0.5 cm (table). Thin sections were prepared for the entire length of 14211-14210 (see table for depth intervals). A large number of allocations were made.

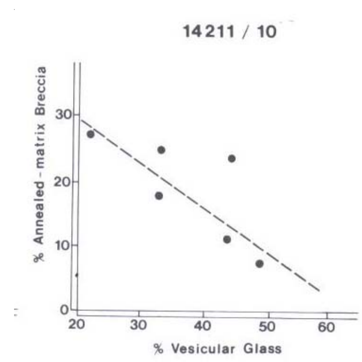

Figure 4: Variation of agglutinates and breccia fragments (Nagle 1979b).

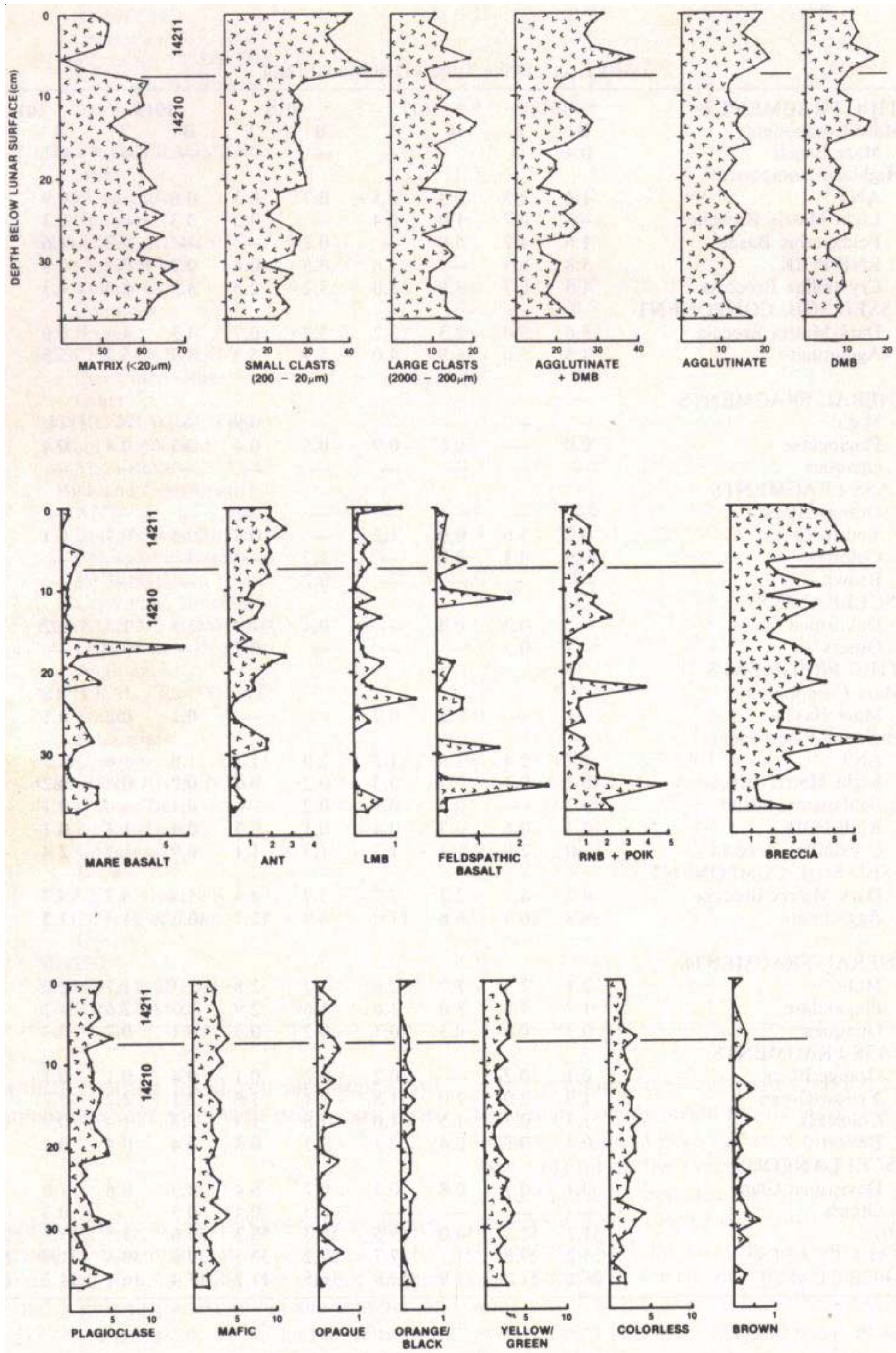

Figure 3: Stratigraphy of 30 levels of double drive tube 14211- 14210 from thin sections (Simon et al. 1982).

Mineralogical Mode for 14211 – 14210
(90 – 1000 micron, from Simon et al. 1982)

	1 cm	13 cm	17 cm	32 cm
Agglutinate	47.8	22.6	46.9	30.5
Mare basalt	2	1	0.5	1.3
Feldspathic basalt	1.4	0.7	0.2	0
ANT	3	5.5	1.4	1.3
Norite (recrystallized)	2.4	7.1	2.6	6
Breccia				
Dark	13.5	26.2	13.5	16.2
Light	1.4	2.6	0.9	1.3
xtln	13.5	4.8	12.1	11.5
Plagioclase	5.8	4.8	5.2	3.4
Pyroxene + olivine	2.4	4.2	5.7	9
Glass other	6.9	19.7	10.9	19.6

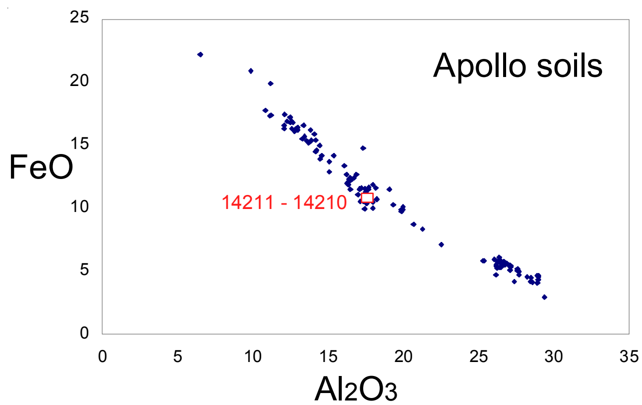

Figure 5: Chemical composition of double drive tube compared with other lunar soils.

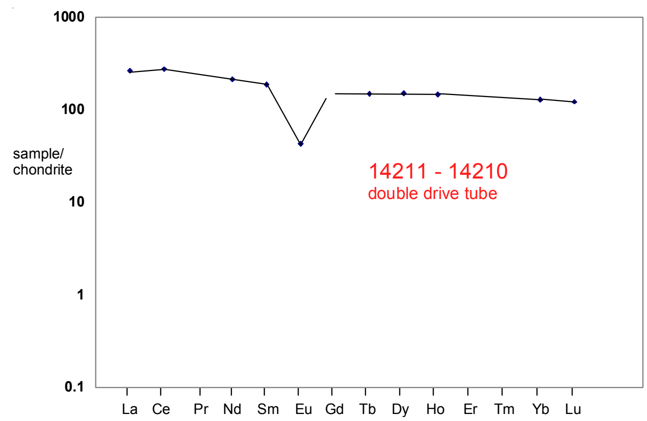

Figure 6: Normalized rare-earth-element diagram for 14211 - 14210.

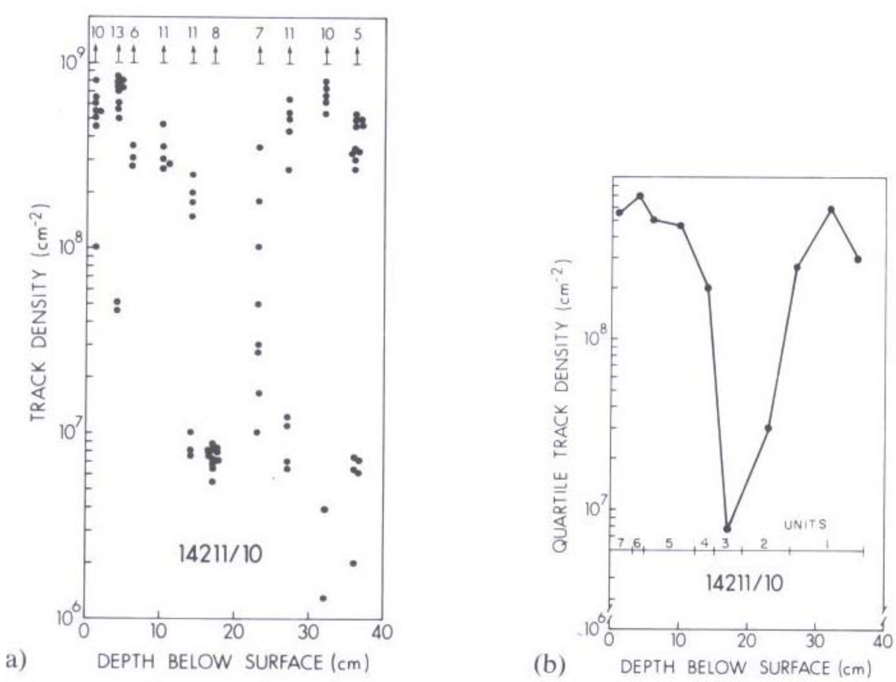

Figure 7: Nuclear particle tracks in double core 14211 - 14210 (Crozaz 1980).

Table 1. Chemical composition of 14210 - 14211.

reference	Laul82										
depth	1 cm	4 cm	10 cm	14 cm	17 cm	23 cm	27 cm	32 cm	36 cm	ave.	
SiO2 %											
TiO2	1.6	1.7	1.6	1.5	1.7	1.6	1.7	1.7	1.7	1.64	(a)
Al2O3	17.5	17.6	17.6	17.5	17.5	17.8	17.5	17.5	17.1	17.5	(a)
FeO	11	11.1	10.4	11.1	11.5	10.4	11	11.3	10.7	10.95	(a)
MnO	0.14	0.14	0.13	0.135	0.135	0.12	0.13	0.14	0.14	0.135	(a)
MgO	9.5	9.6	9	9.5	9.5	9.6	9.5	10	9.1	9.5	(a)
CaO	10.5	11.3	10.7	10.4	10.5	11.7	11.1	10.4	11.2	10.9	(a)
Na2O	0.72	0.71	0.71	0.7	0.71	0.69	0.71	0.69	0.68	0.7	(a)
K2O	0.51	0.51	0.52	0.51	0.52	0.51	0.53	0.52	0.51	0.515	(a)
Cr2O3	0.19	0.2	0.19	0.2	0.205	0.205	0.205	0.205	0.21	0.2	(a)
S %											
sum											
Sc ppm	23	23	21.8	23.1	24	21.7	22.9	24	22.2	22.9	(a)
V	40	45	40	40	45	45	40	45	45	42.8	(a)
Cr											
Co	43.5	36	32.6	34.2	31	33	37	33.4	35.7	35.1	(a)
Ni	650	340	340	690	500	370	380	440	400	457	(a)
Cu											
Zn											
Ga											
Ge ppb											
As											
Se											
Rb											
Sr	210	180	170	180	170	170	190	190	200	185	(a)
Y											
Zr	730	800	760	840	830	910	790	790	770	802	(a)
Nb											
Mo											
Ru											
Rh											
Pd ppb											
Ag ppb											
Cd ppb											
In ppb											
Sn ppb											
Sb ppb											
Te ppb											
Cs ppm											
Ba	850	790	730	710	770	750	760	730	730	758	(a)
La	64.1	62.5	64.3	64.1	60	60	64.3	59	62	62.2	(a)
Ce	170	170	160	160	160	170	170	170	170	167	(a)
Pr											
Nd	100	100	100	100	100	90	95	100	100	98	(a)
Sm	28.5	26.2	28.6	27.5	27	27.5	29	26.7	27.8	27.6	(a)
Eu	2.4	2.4	2.4	2.45	2.4	2.25	2.4	2.4	2.4	2.4	(a)
Gd											
Tb	5.4	5.4	5.35	5.25	5.6	5.3	5.5	5.5	5.55	5.43	(a)
Dy	38	39	36	35	38	35	34	36	41	36.9	(a)
Ho	7.9	8.6	7.6	8	8.3	8.7	8.4	8	8.4	8.2	(a)
Er											
Tm	3	3	3.1	3.3	2.9	2.9	2.9	3.1	3	3	(a)
Yb	22	20.2	21	21.3	21.1	21.1	22.2	20.5	21.1	21.2	(a)
Lu	3	2.8	3.02	2.9	2.96	3	3.1	2.9	2.94	3	(a)
Hf	21.9	21.6	21.1	20.9	23.5	25	21	20.7	21.7	22	(a)
Ta	3.3	3.1	2.7	3	2.8	2.8	3.1	3.1	3	3	(a)
W ppb											
Re ppb											
Os ppb											
Ir ppb											
Pt ppb											
Au ppb											
Th ppm	14	11.8	12	12.2	12.6	11.3	11.5	12.1	11.9	12	(a)
U ppm	3.9	3.2	3.3	3.3	3.3	3.2	3.2	3.1	3.2	3.3	(a)

technique: (a) INAA

Dissection intervals of 14211-14210

depth	split	weight
cm	< 1 mm	grams
0 - 0.5	14211,3	1.27
0.5 - 1.0	,5	2
1.0 - 1.5	,7	1.7
1.5 - 2.0	,9	1.8
2.0 - 2.5	,11	2.1
2.5 - 3.0	,13	2
3.0 - 3.5	,15	2
3.5 - 4.0	,17	1.7
4.0 - 4.5	,19	1.9
4.5 - 5.0	,21	2.1
5.0 - 5.5	,23	1.9
5.5 - 6.0	,25	1.8
6.0 - 6.5	,27	2.1
6.5 - 7.0	,29	2
7.0 - 7.4	,31	1.2
7.4 - 7.7	,33	1.1
7.7 - 8.5	14210,19	2.5
8.5 - 9.0	,21	1.3
9.0 - 9.5	,23	1.5
9.5 - 10	,25	2
10 - 10.5	,27	1.8
10.5 - 11	,29	1.9
11 - 11.5	,31	1.7
11.5 - 12	,33	1.7
12 - 12.5	,35	1.4
12.5 - 14	,37	1.4
12.5 - 14	,39	1.5
14 - 14.5	,41	1.4
14.5 - 15	,43	0.8
15 - 15.5	,45	1.3
15.5 - 16	,47	1.8
16 - 16.5	,49	2
16.5 - 17	,51	1.8
17 - 17.5	,53	1.7
17.5 - 18	,55	1.9
18 - 18.5	,57	1.6
18.5 - 19	,59	2
19 - 19.5	,61	2
19.5 - 20	,53	1.9
20.5 - 21	,65	1.9
21 - 21.5	,67	1.8
21.5 - 22	,69	1.8
22 -22.5	,71	1.6
22.5 - 23	,73	2
22.5 - 22.9	,75	1.7
22.9 - 23.5	,77	1.8
23.5 - 24	,79	1.9
24 - 24.5	,81	1.7
24.5 - 25	,83	1.8
25 - 25.5	,85	1.4
25.5 - 26	,87	1.8
26 - 26.5	,89	1.6
26.5 - 27	,91	1.2
27 - 27.5	,93	1.5
27.5 - 28	,95	2
28 - 28.5	,97	1.8
28.5 - 29	,99	1.7
29 - 29.5	,101	1.8
29.5 - 30	,103	1.7
30 - 30.5	,105	1.6
30.5 - 31	,107	1.9
31 - 31.5	,109	2.7
31.5 - 32	,112	1.9
32 - 32.5	,114	1.5
32.5 - 33	,116	2.1
33 - 33.5	,118	1.9
33.5 - 34	,120	2
34 - 34.5	,122	1.4
34.5 - 35	,124	1.6
35 - 35.5	,126	1.6
35.5 - 36	,128	1.5
36 - 36.5	,130	1.8
36.5 - 37	,132	2
37 - 37.6	,134	2

List of potted-butts, thin-sections, 14211-14210.

depth	PB	TS
14211		
0 - 1.6 cm	,1004	,1007
1.6 - 4.8	,1005	,1008
4.8 - 7.4	,1006	,1009
14210		
7.4 - 10.5	,1006	,1018
10.5 - 12.4	,1007	,1019
12.4 - 15.2	,1008	,1020
15.2 - 17.2	,1009	,1021
17.2 - 20	,1010	,1022
20 - 22.5	,1011	,1023
22.5 - 25	,1012	,1024
25 - 27.5	,1013	,1025
27.5 - 30	,1014	,1026
30 - 32.5	,1015	,1027
32.5 - 35	,1016	,1028
35 - ~38	,1017	,1029

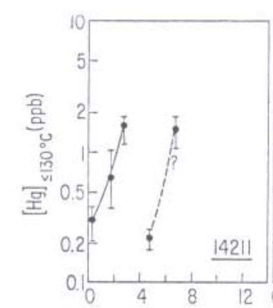

Figure 8: Variation of Hg content with depth (Jovanovic and Reed 1979).

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W1

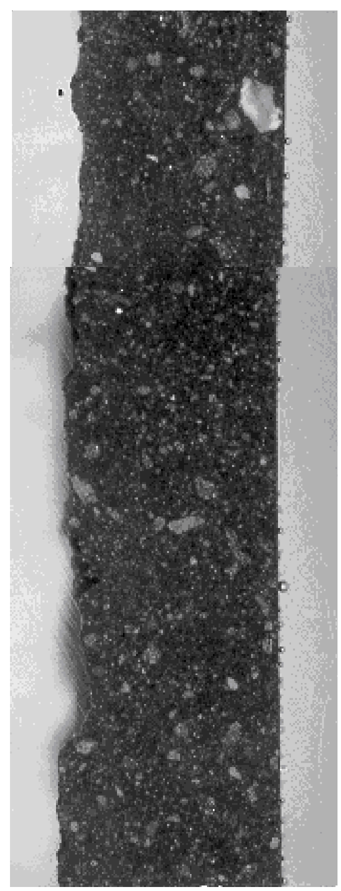
14211,1003
epoxy
encapsulated
core
*(slumping at
both ends)*

~ lunar surface

,1004 PB
,1007 TS

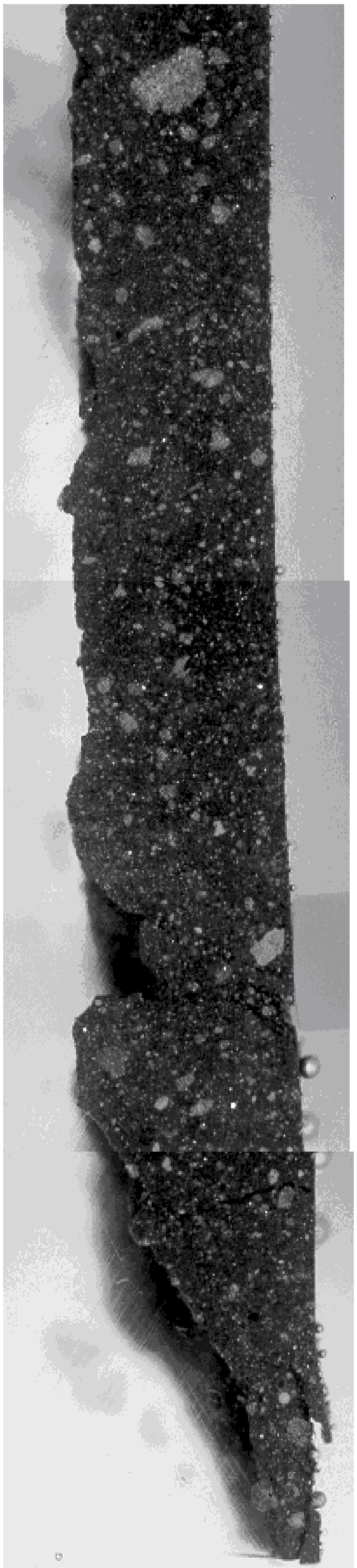
~ 1 cm depth

~ 2 cm depth



,1005 PB
,1008 TS

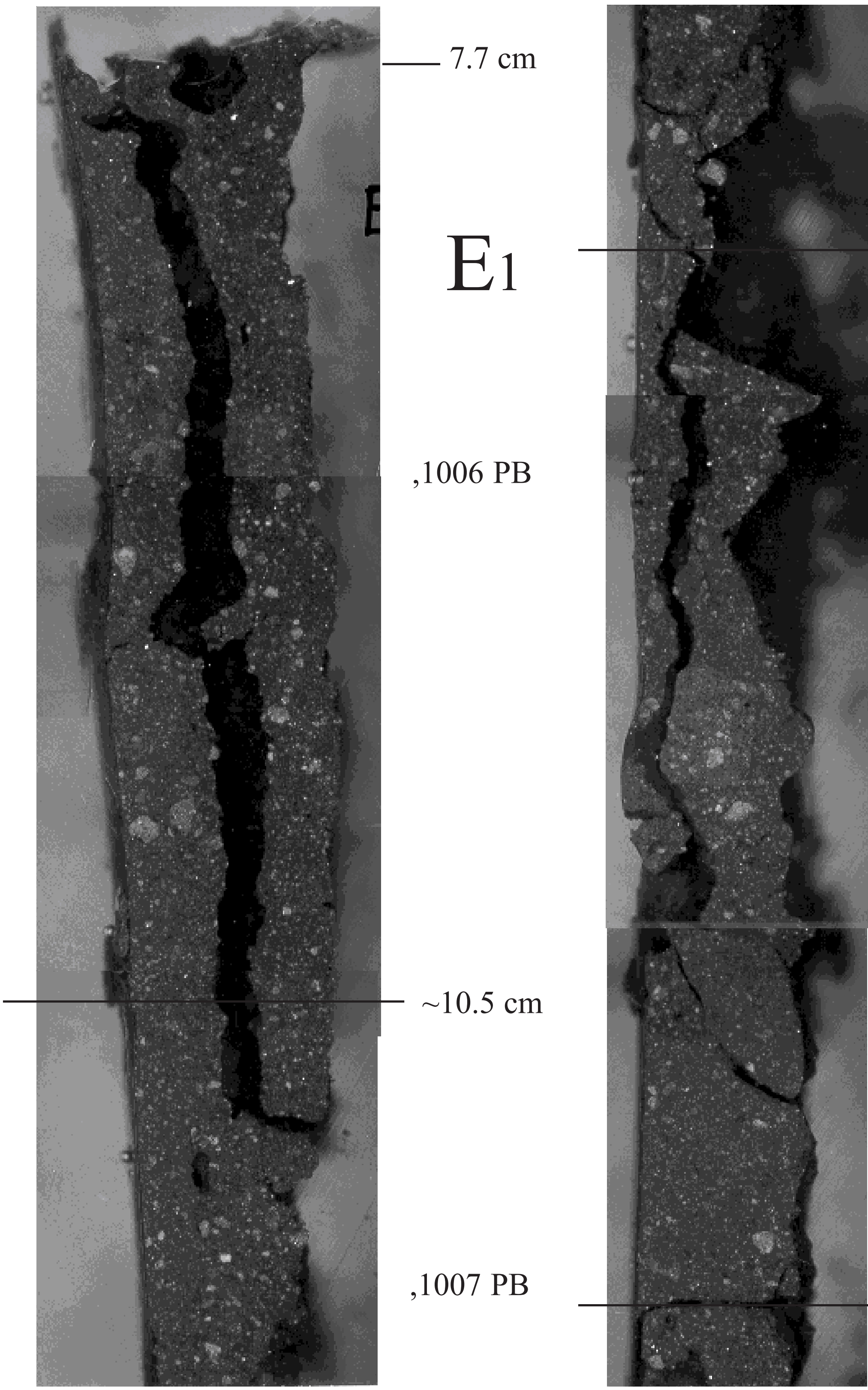
~ 3 cm depth

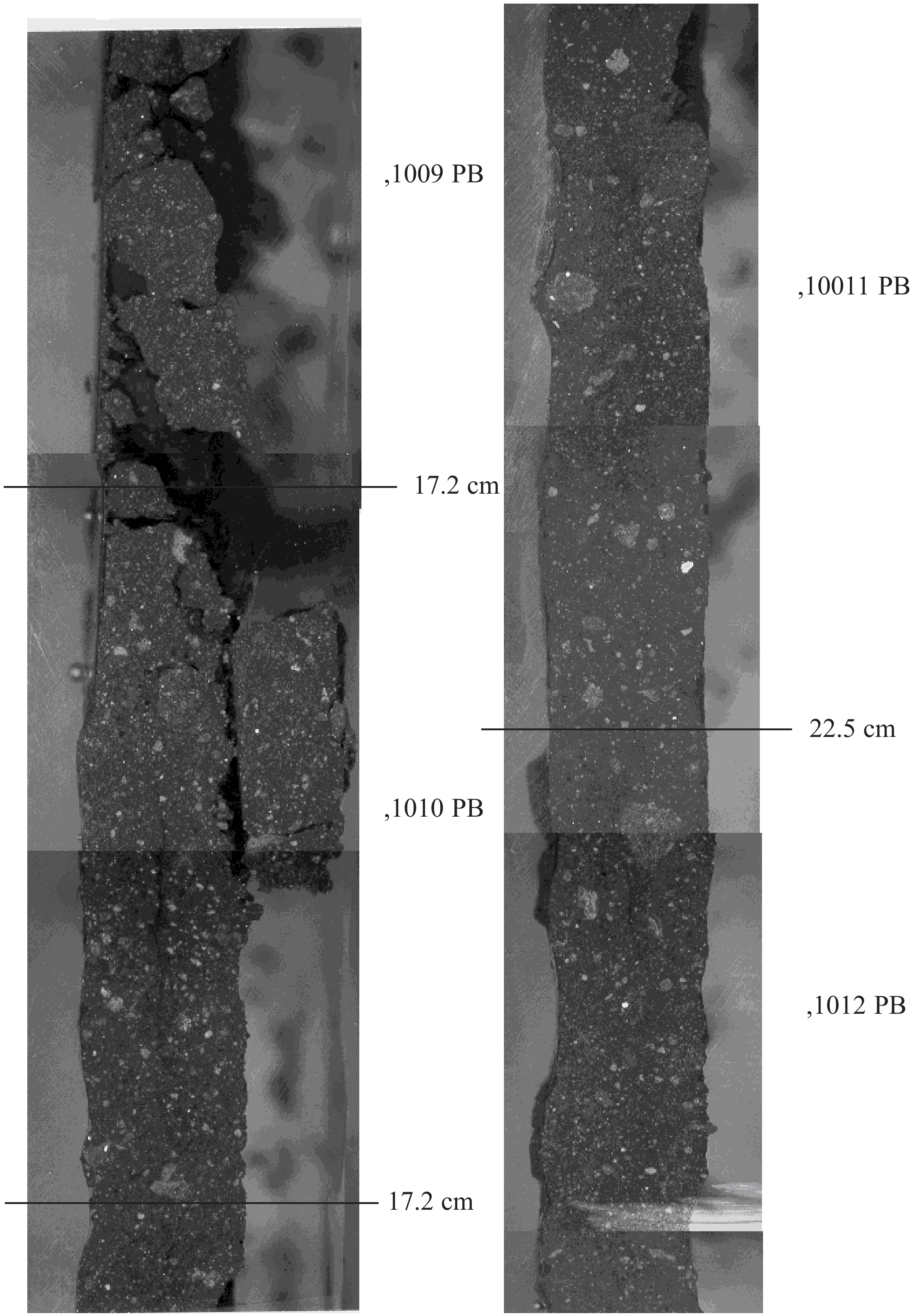


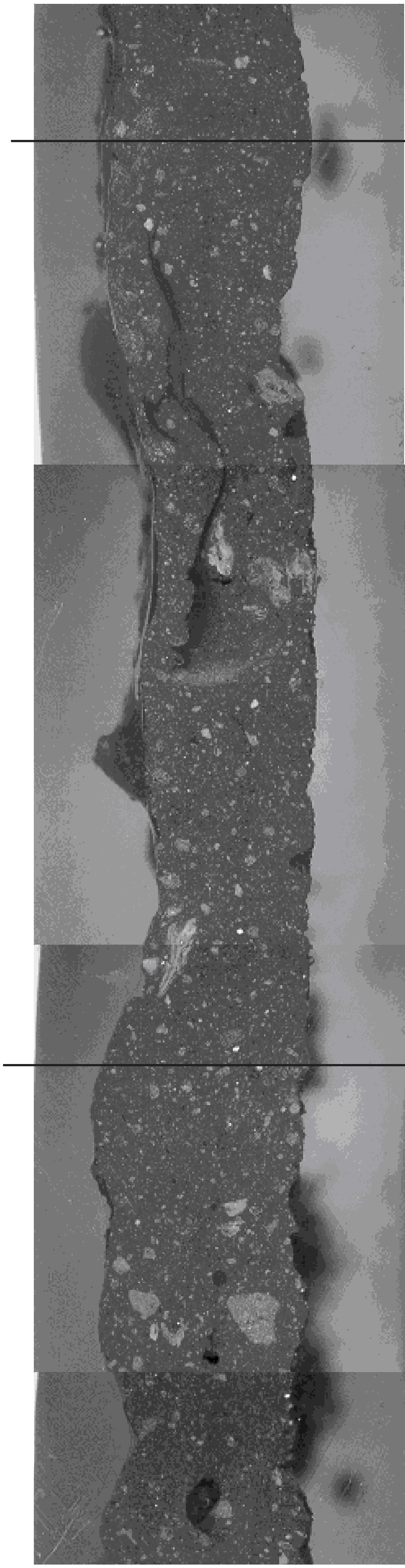
note: 14210 ajoins this end

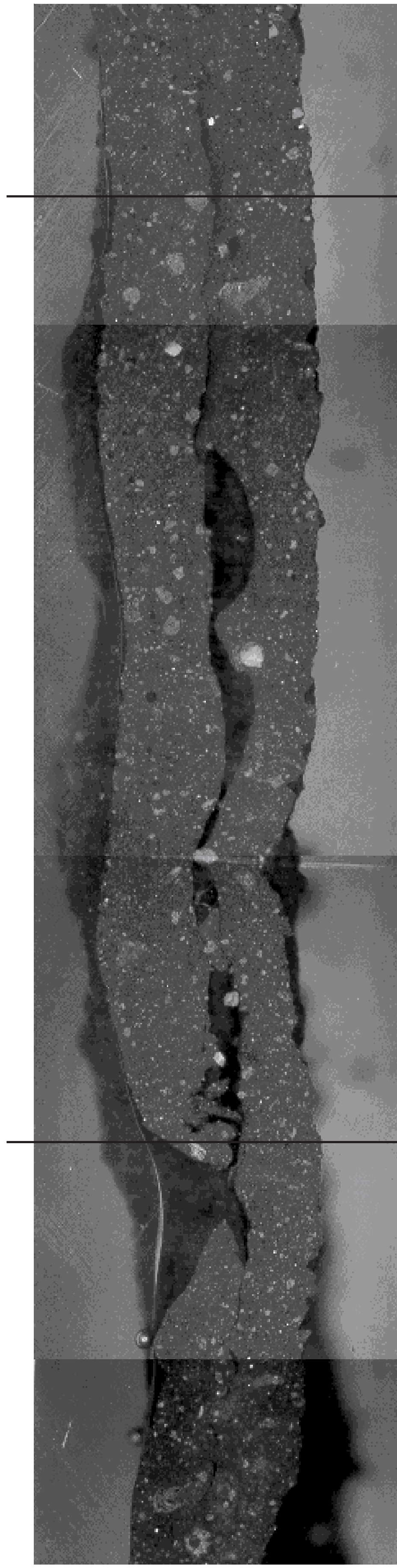
14210,1000 epoxy encapsulated core bottom segment

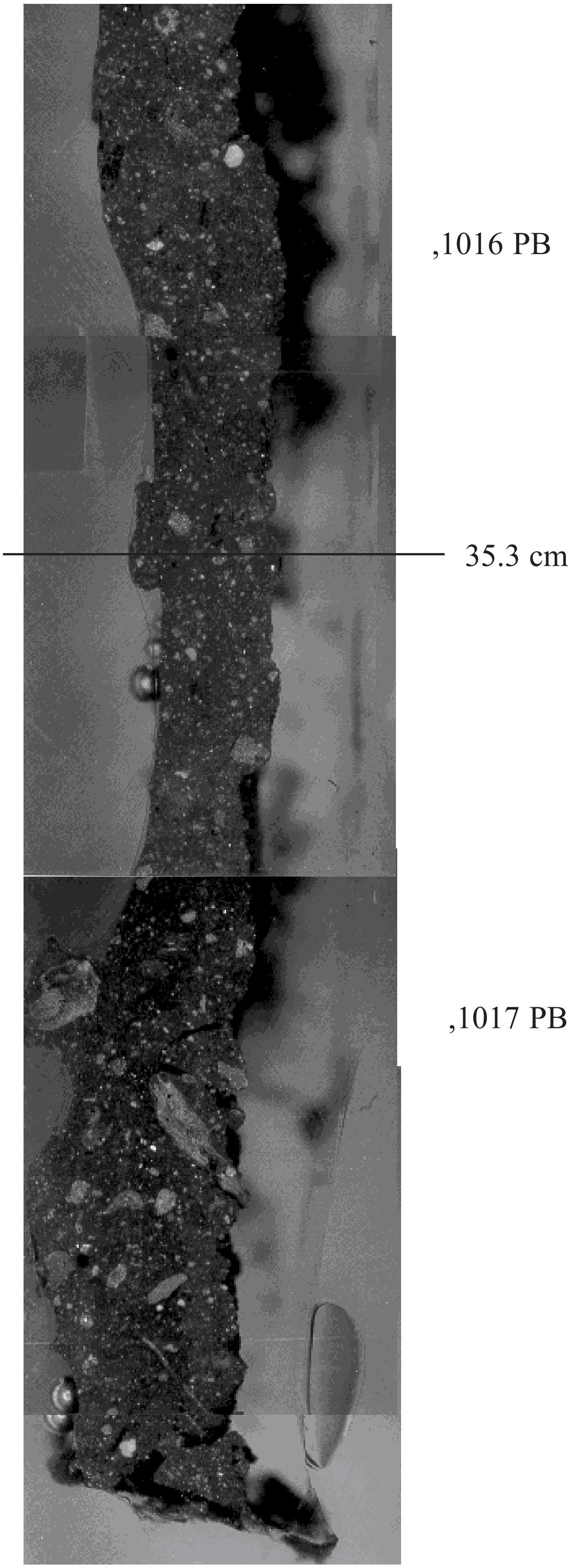
continued from 14211




,1009 PB
17.2 cm
,1010 PB
17.2 cm
,10011 PB
22.5 cm
,1012 PB


25.0 cm
,1013 PB
27.5 cm
,1014 PB


30.0 cm
,1015 PB
32.5 cm
,1016 PB


,1016 PB
35.3 cm
,1017 PB