DRAFT

64002 - 64001

Double Drive Tube

Station 4

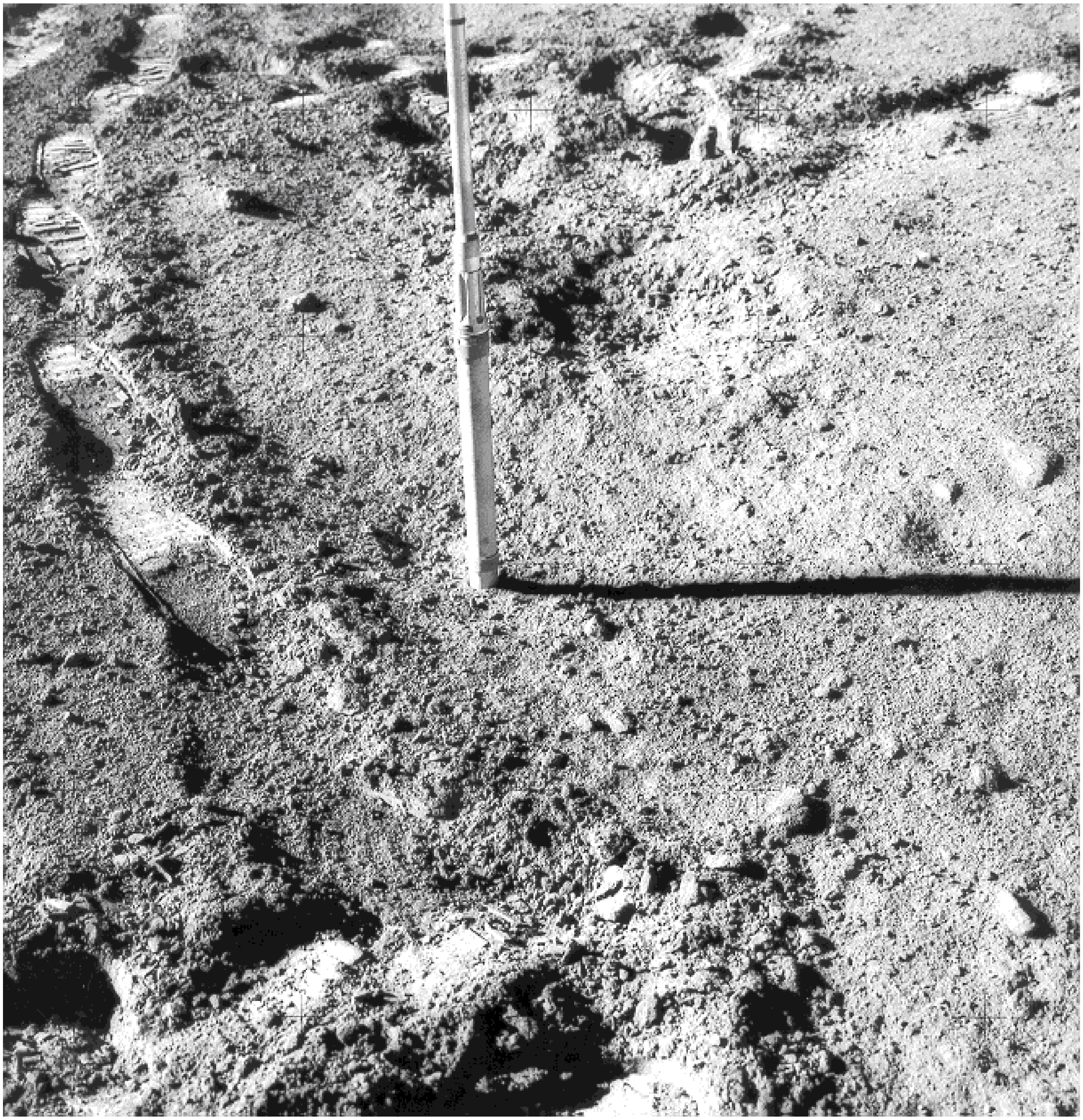

Figure 1: Double drive tube taken in small double crater near rim of Cinco 'a' on Stone Mountain, Apollo 16. AS16-110-17950. Note the soft soil.

LMP: *I don't want to get down there to far. This thing is deep. I'm to the 2:30 position of the rover, and I'm going to start with this double core – got it assembled. Okay. I pushed it in. I got in almost to the top of the first stem by pushing it in.*
LMP: *Okay, Tony, about halfway up the second one – it's getting a little harder, but it's going on in.*

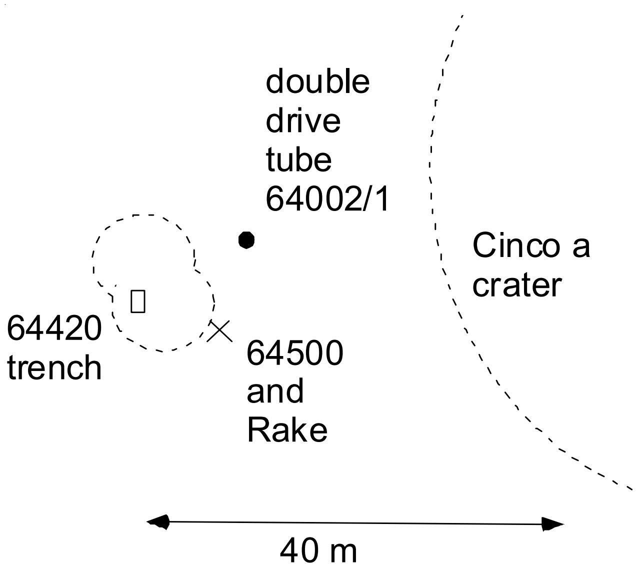

Figure 2: Map of station 4 on Stone Mountain with locations of soils samples.

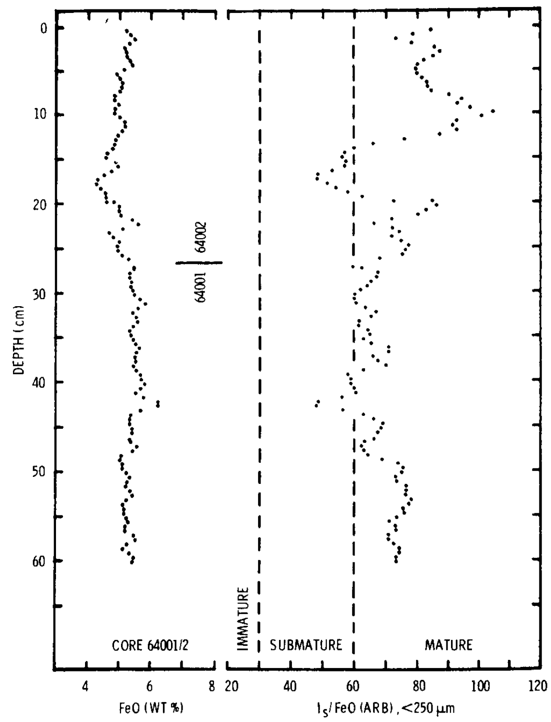

Figure 3: Maturity of double drive tube 64002 - 64001 (from Korotev et al. 1984).

Introduction

Samples from station 4, high up on Stone Mountain, should primarily be materials from the Descartes Formation (Muehlberger et al. 1980). A double drive tube (~ 60 cm) was taken in loose, blocky, regolith on the rim of a 15 meter crater (figure 1). Soil sample 64500, rake 64530, trench 64420 and several rocks were collected adjacent to this double drive tube (figure 2).

However, a ray from South Ray Crater extends in this direction and the blocky area were these sample were taken may have been caused by ejecta from South Ray Crater (samples 64425, 64455, 64475 etc.).

The core has three chemically distinct regions (top 20 cm, 20 to 48 cm and 48 to 60 cm).

Petrography

Horz et al. (1972) and Mahmood et al. (1974) noted a change in grain size and an abundance of rock fragments at a depth of 50 cm. A nearby penetrometer experiment also noted a change in penetration resistance at about 50 cm (Mitchell et al. 1972).

Morris and Lauer (1982) and Korotev et al. (1984) reported the maturity along the length of the double drive tube (figure 3), noting several distinct changes. The top 12 cm seems to be 'disturbed', possibly 2 m.y. ago by the ray from South Ray Crater. Overall, the core has high maturity.

Analysis of the modal data by Houck (1982) and Basu and McKay (1984) indicates that the upper and lower portions of 64002 may have had different source rocks (Papike et al. 1982). Houck (1982) suggests that the soils formed by mixing a plagioclase-rich soil with two different mature soils. Note that there is little to no observable mare basalt component in the mode, because the mare component is present in glass and dark matrix breccias.

Nishiizumi et al. (1982) conclude that the top 20 cm was recently disturbed (~ 3 m.y. ago).

Chemistry

According to Korotev (1984), the station 4 core has three chemically distinct regions (top 20 cm, 20 to 48 cm and 48 to 60 cm). These are compared with the chemistry of 64501 in table 1 and figure 5. Korotev (1984) reports an enrichment in the mare component in the region form 26 to 48 cm. compared with the deeper material. There is a thin layer at about 43 cm depth that has as much as 12 % mare basalt (according

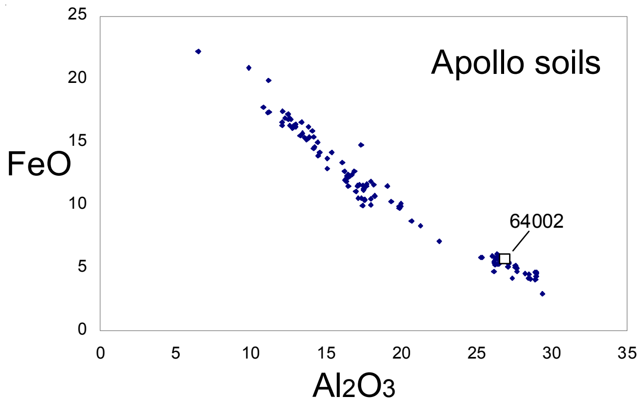

Figure 4: Chemical composition of station 4 double drive tube 64002-1 compared with all other lunar soils.

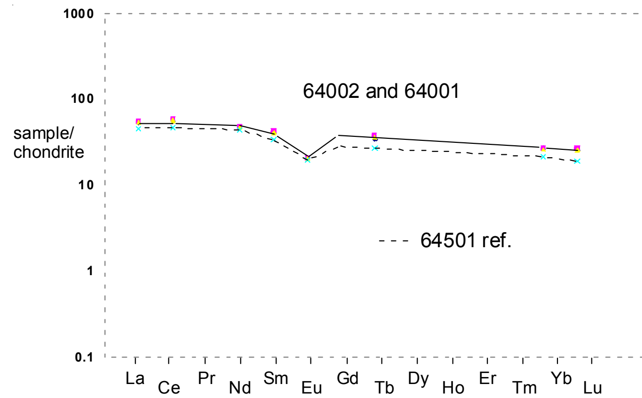

Figure 5: Normalized rare-earth-element diagram comparing composition of 64002 - 1 with that of reference soil 64501.

to Korotev et al. 1984). This is higher than anywhere else at Apollo 16.

Cosmogenic isotopes and exposure ages

Nishiizumi et al. (1983) determined ^{53}Mn along the length of the core 64002 (figure 8). They seem to have found that the top of the core had been recently "disturbed", which would also apply to the trench soil, 64421 (which also seems to be unusually mature at depth).

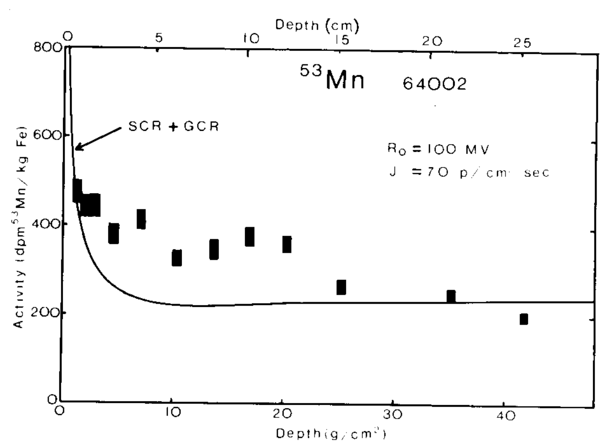

Figure 8: Cosmic-ray-induced activity of 53Mn as function of depth in 64002 (from Nishiizumi et al. 1983). Lack of comparison with predicted indicates that regolith has been 'disturbed' recently.

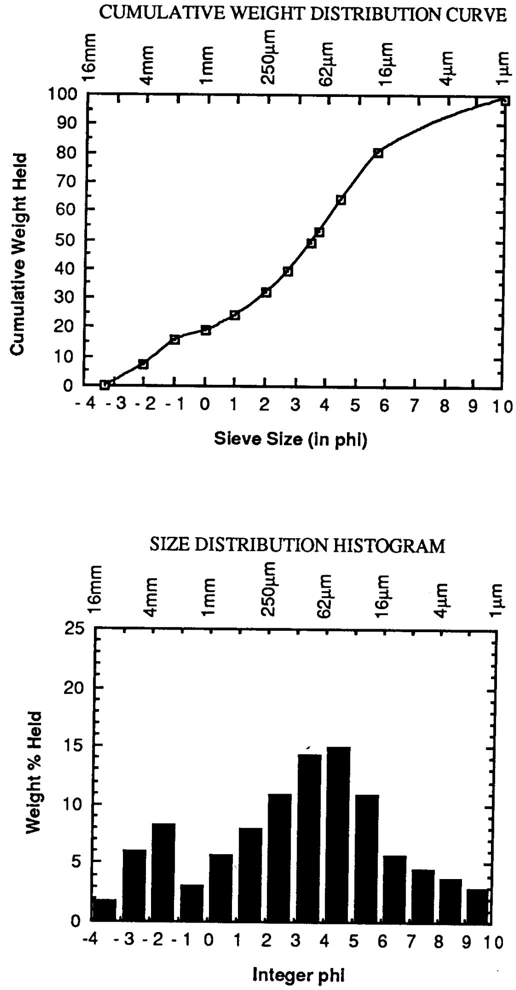

Figure 6: Grain size distribution of 64002 (5 cm) (from Graf 1993; data from McKay et al).

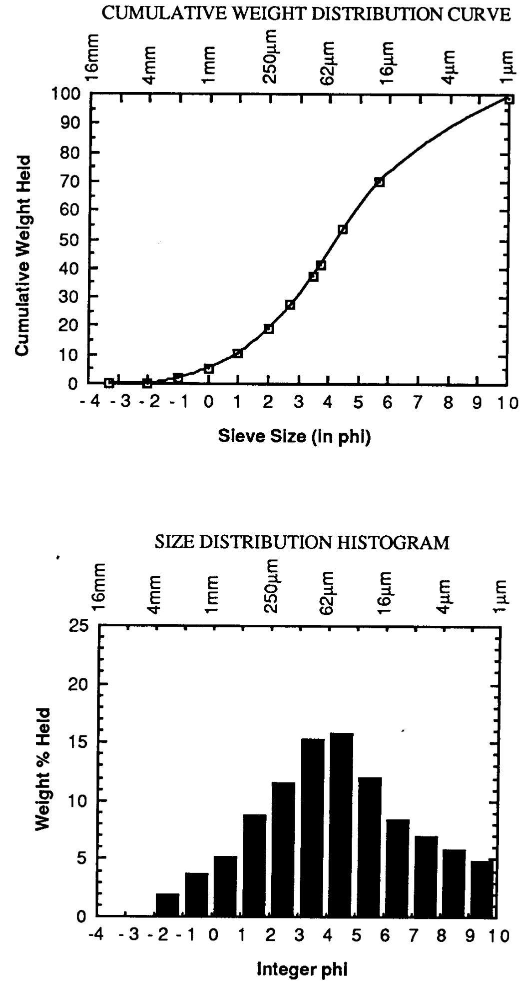

Figure 7: Grain size distribution of 64001 (52 cm) (from Graf 1993; data from McKay et al).

Modal analysis for 64002 - 1.

	Houck 82						Basu 83					
	60002						60001					
depth	0.5 cm	5.5 cm	10.5 cm	15 cm	18.5 cm	24.5 cm	28	35.5	42.5	47	52.5	59.5
Agglutinates	41	36	40	24	26	35	29	26	26	30	38	39
Plagioclase	18	18	19	35	34	20	20	22	24	24	22	21
Olivine	0.1	0.1	0.1		0.1		0.1		0.1	0.2		0.3
Pyroxene	2	4	3	3	3	3	7	4.5	5.8	3.9	3	4
Opaques							0.3	0.1	0.6	0.6	0.2	0.4
Anorthosite, norite	0.8	0.4	0.3	1.6	1.7	1.3	0.5	1	0.5	0.3	0.4	0.2
Mare Basalt		0.2	0.1	0.1	0.2	0.2	0.5	0.9	1.2	0.4	0.2	0.1
other basalt			0.1	0.1	0.1		0.1			0.1	0.3	0.1
Fragmetal breccias	15	20	16	15	12	15	15	19	21	17	12	13
Cyrstalline matrix bx.	14	13	15	14	14	14	17	15	15	13	14	13
Glass	8	8	6	8	9	10	11	11	6	9	11	8

Table 1. Chemical composition of 64001 - 2.

						ref soil	
reference	Korotev 82	Korotev 84				Korotev 91	
weight	64002	64001				64501	
SiO2 %	0 - 26 cm	26-60	26-48	48-60 cm			
TiO2	average of 10						
Al2O3	27.1						
FeO	5.04	5.42	5.44	5.23	(a)	4.14	(a)
MnO	0.067						
MgO	5.51						
CaO	15.9					16	(a)
Na2O	0.472	0.47	0.47	0.46	(a)	0.45	(a)
K2O							
P2O5							
S %							
sum							
Sc ppm	8.66	10.14	10.25	9.11	(a)	7.48	(a)
V							
Cr	666	774	778	730	(a)	581	(a)
Co	30	28	28	29	(a)	20.9	(a)
Ni	414	404	394	425	(a)	311	(a)
Cu							
Zn							
Ga							
Ge ppb							
As							
Se							
Rb							
Sr	180	181	181	184	(a)	167	(a)
Y							
Zr	170	215	217	210	(a)	129	(a)
Nb							
Mo							
Ru							
Rh							
Pd ppb							
Ag ppb							
Cd ppb							
In ppb							
Sn ppb							
Sb ppb							
Te ppb							
Cs ppm						0.1	(a)
Ba	153	145	147	141	(a)	124	(a)
La	12.5	13	13.1	12.7	(a)	10.8	(a)
Ce	33.2	35.2	35.5	34.2	(a)	28.1	(a)
Pr							
Nd		21.8	22.1	21.2	(a)	20	(a)
Sm	5.97	6.21	6.27	6	(a)	5.06	(a)
Eu	1.155	1.16	1.16	1.15	(a)	1.11	(a)
Gd							
Tb	1.24	1.37	1.38	1.31	(a)	0.98	(a)
Dy							
Ho							
Er							
Tm							
Yb	4.32	4.41	4.47	4.23	(a)	3.51	(a)
Lu	0.634	0.65	0.66	0.625	(a)	0.471	(a)
Hf	4.66	4.76	4.81	4.59	(a)	3.65	(a)
Ta	0.73	0.56	0.57	0.55	(a)	0.44	(a)
W ppb							
Re ppb							
Os ppb							
Ir ppb	12.6	13.8				8.8	(a)
Pt ppb							
Au ppb		6.7				13.9	(a)
Th ppm	2.71	2.25	2.26	2.2	(a)	1.76	(a)
U ppm	0.675	0.54	0.54	0.53	(a)	0.54	(a)

technique: (a) INAA

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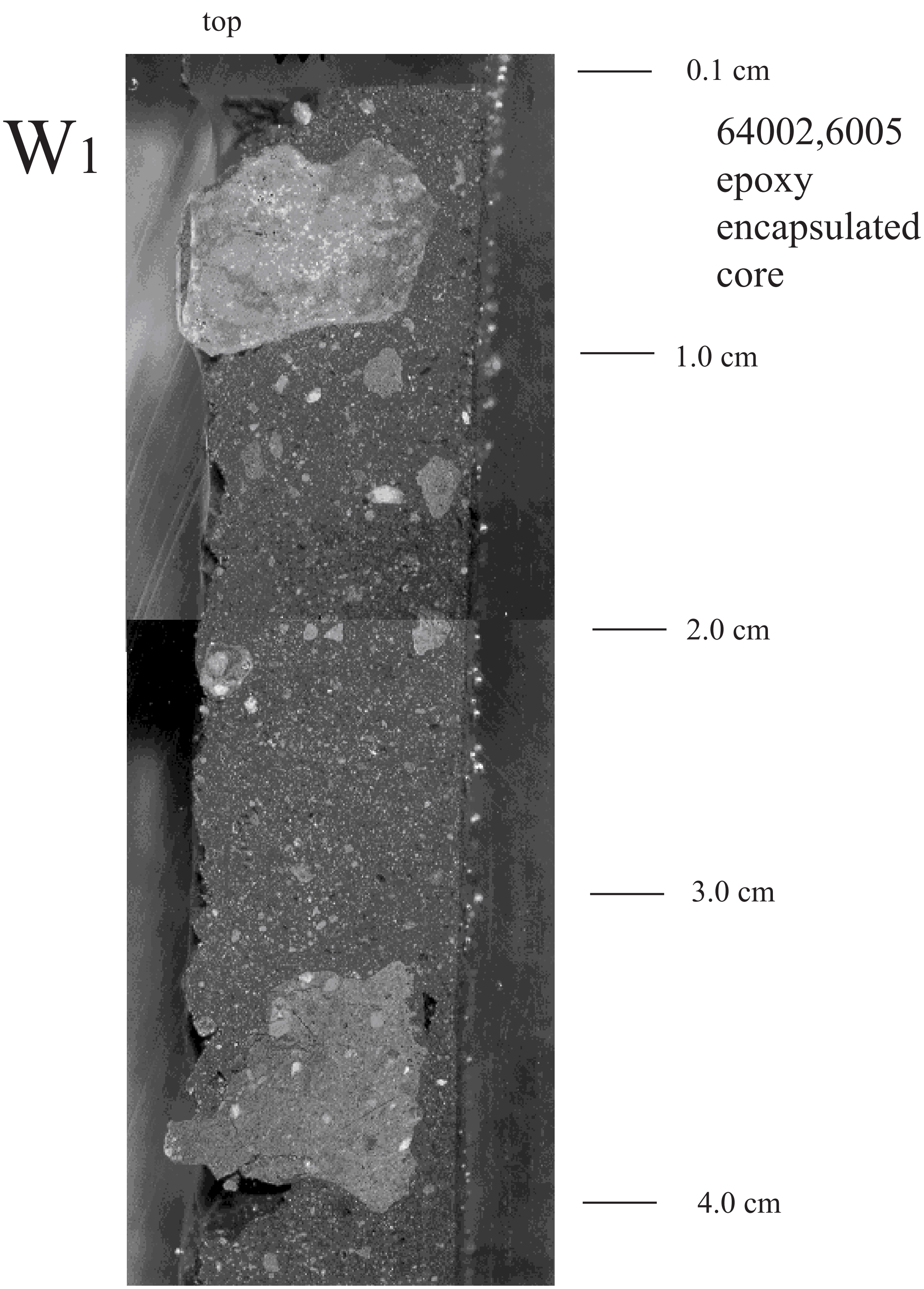
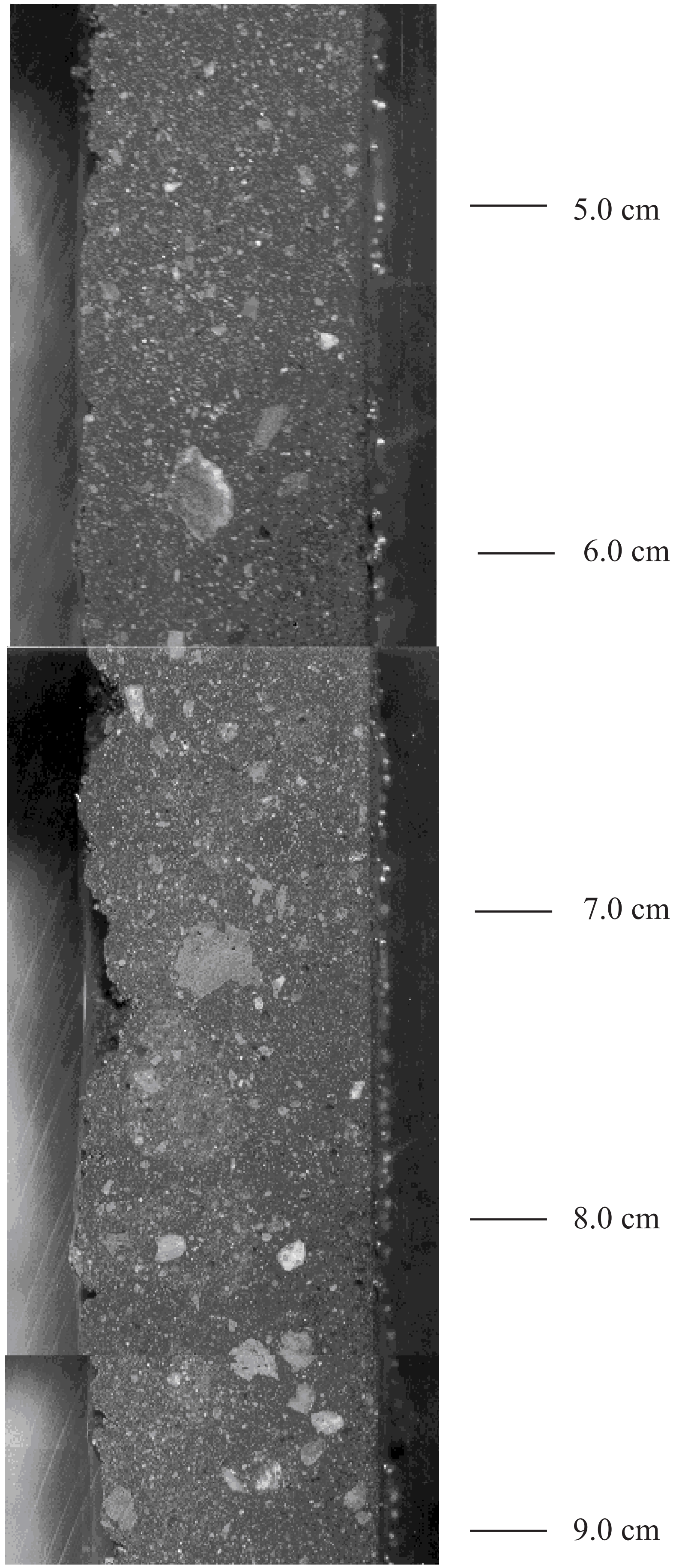

top
W1
0.1 cm
64002,6005
epoxy
encapsulated
core
1.0 cm
2.0 cm
3.0 cm
4.0 cm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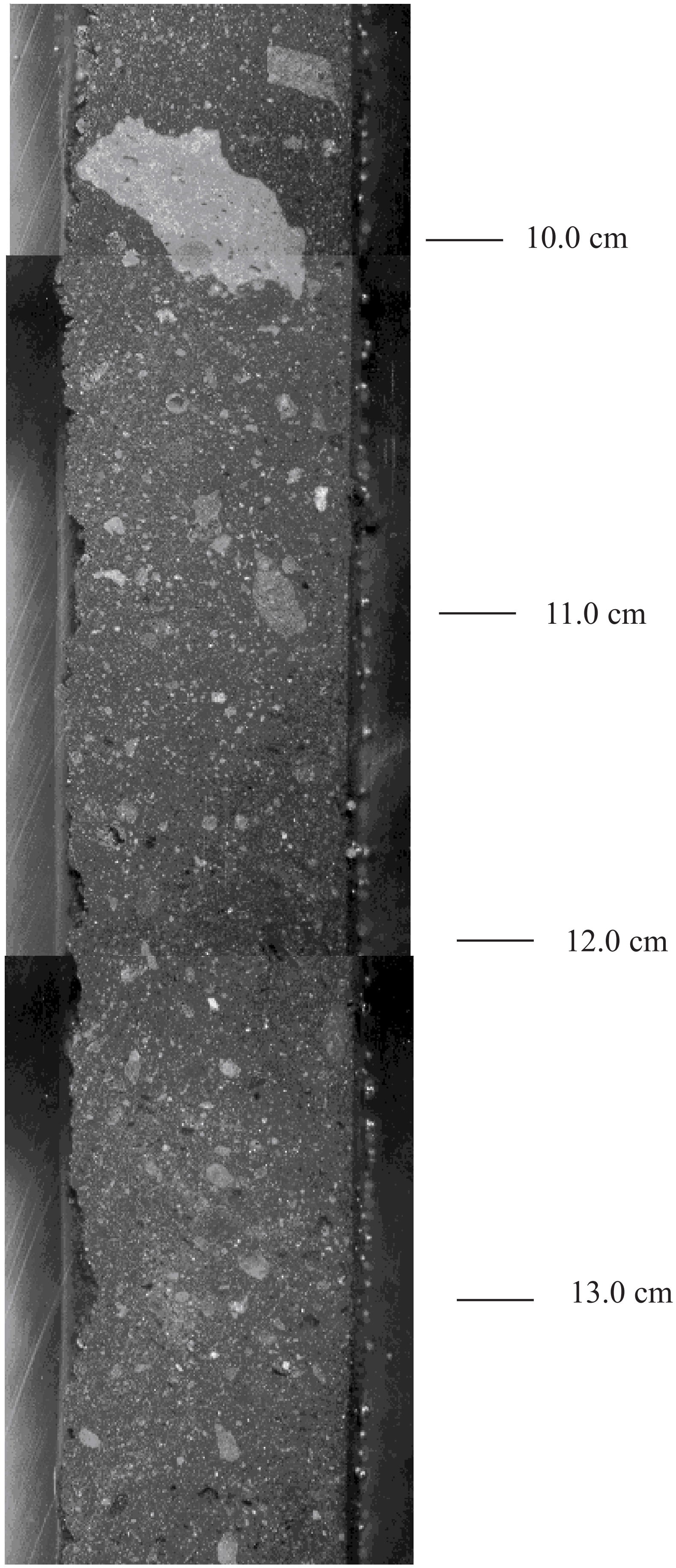
6.0 cm
7.0 cm
8.0 cm
9.0 cm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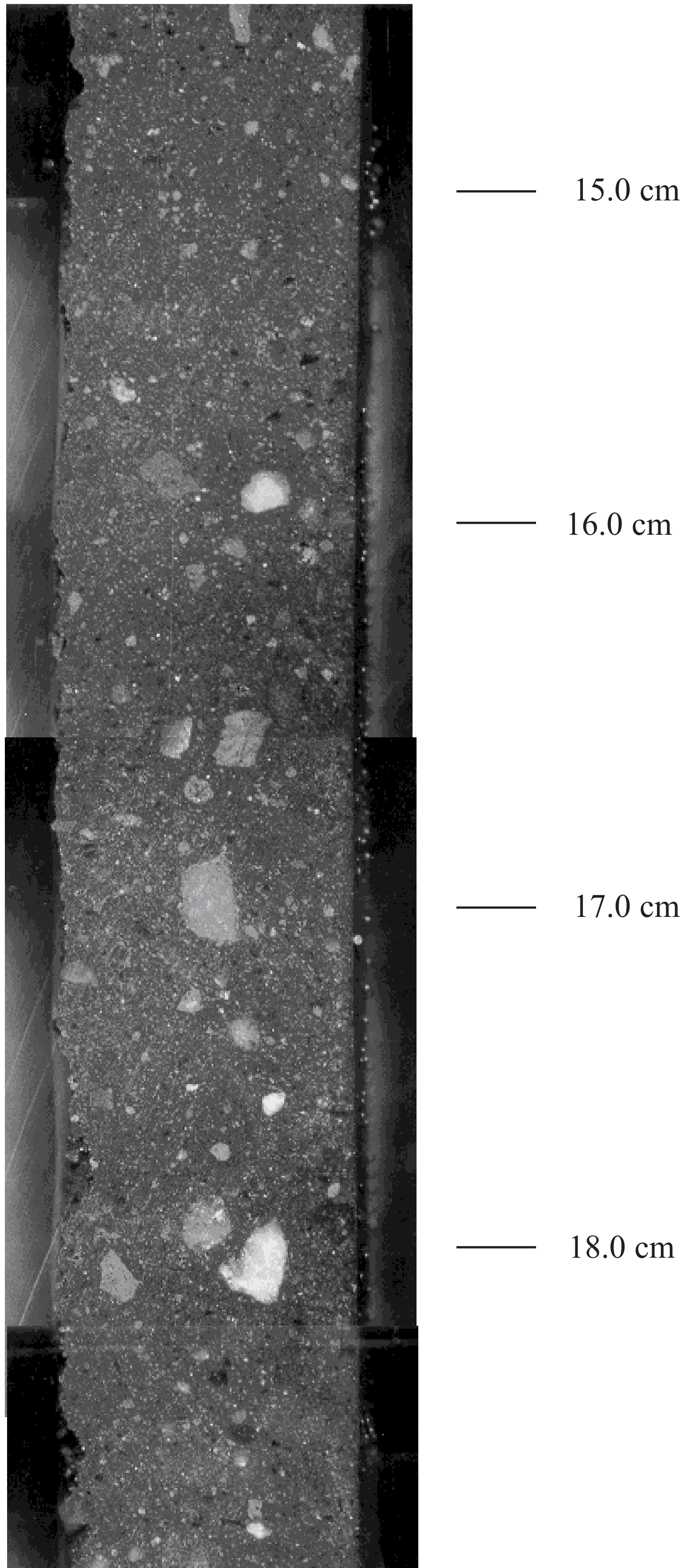
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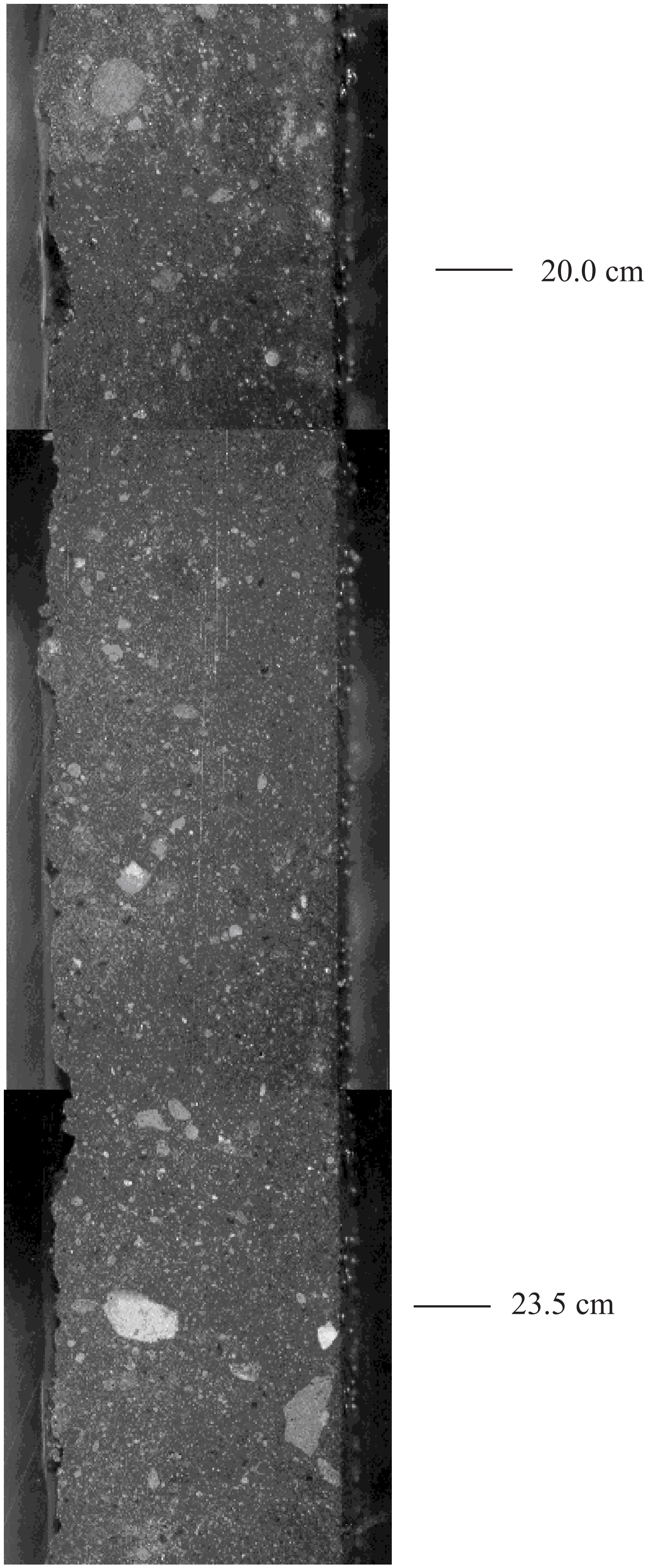
17.0 cm
18.0 cm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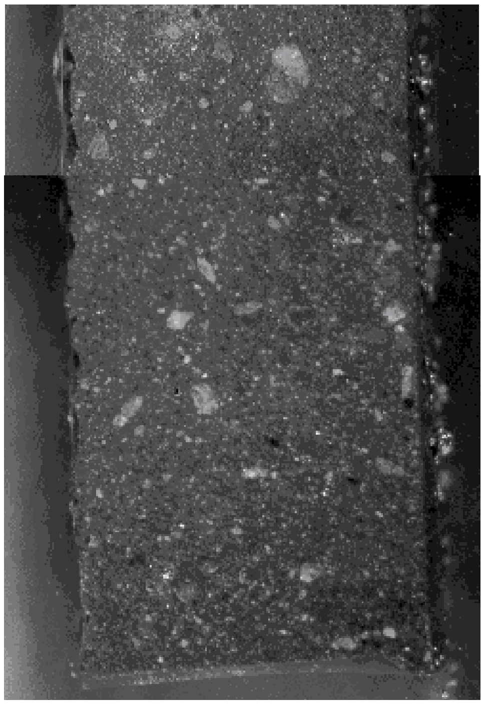
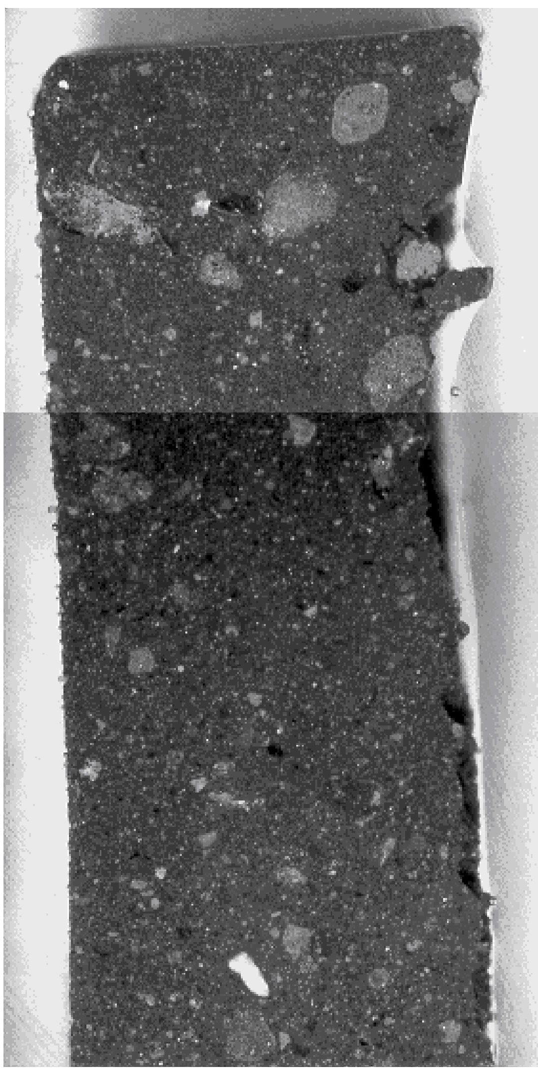
23.5 cm



26.0 cm

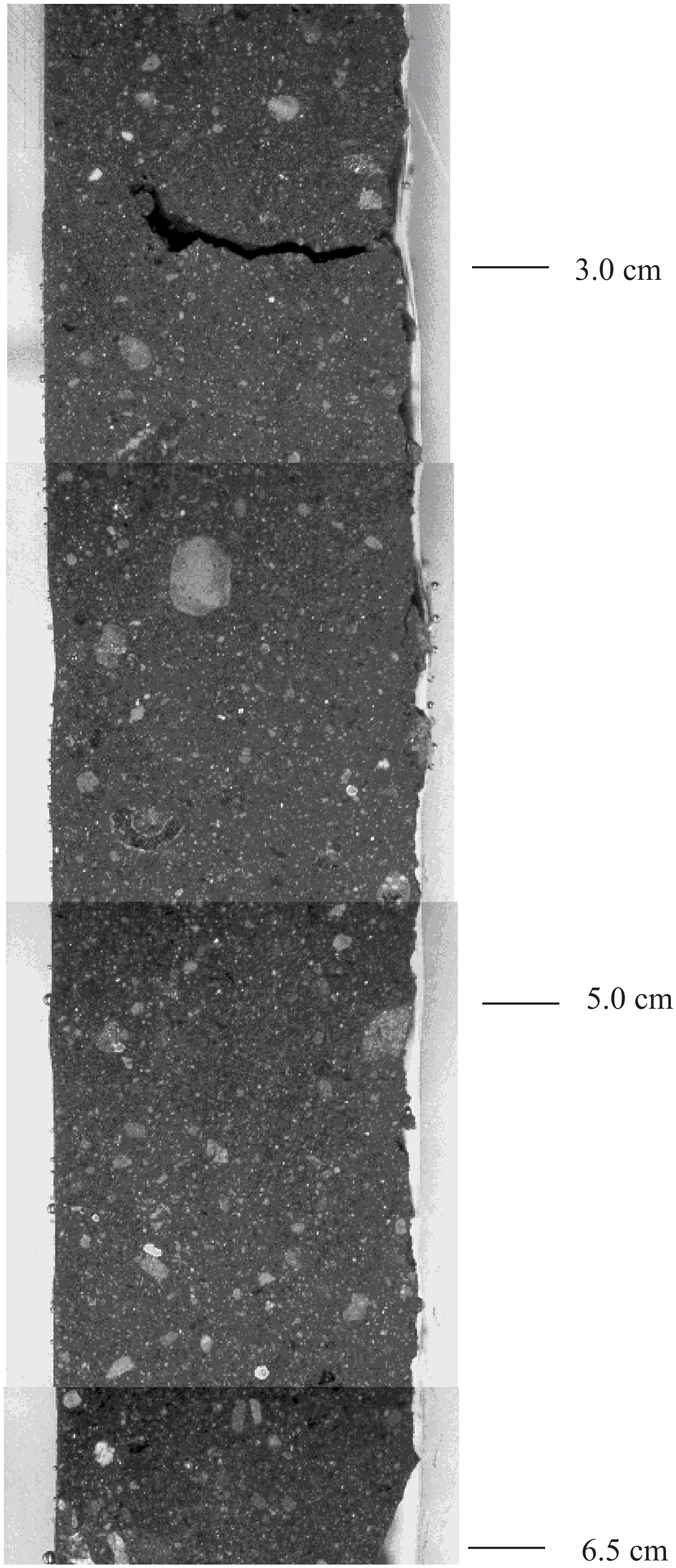
0.0 cm



64001,6008
epoxy
encapsulated
core

E1

2.0 cm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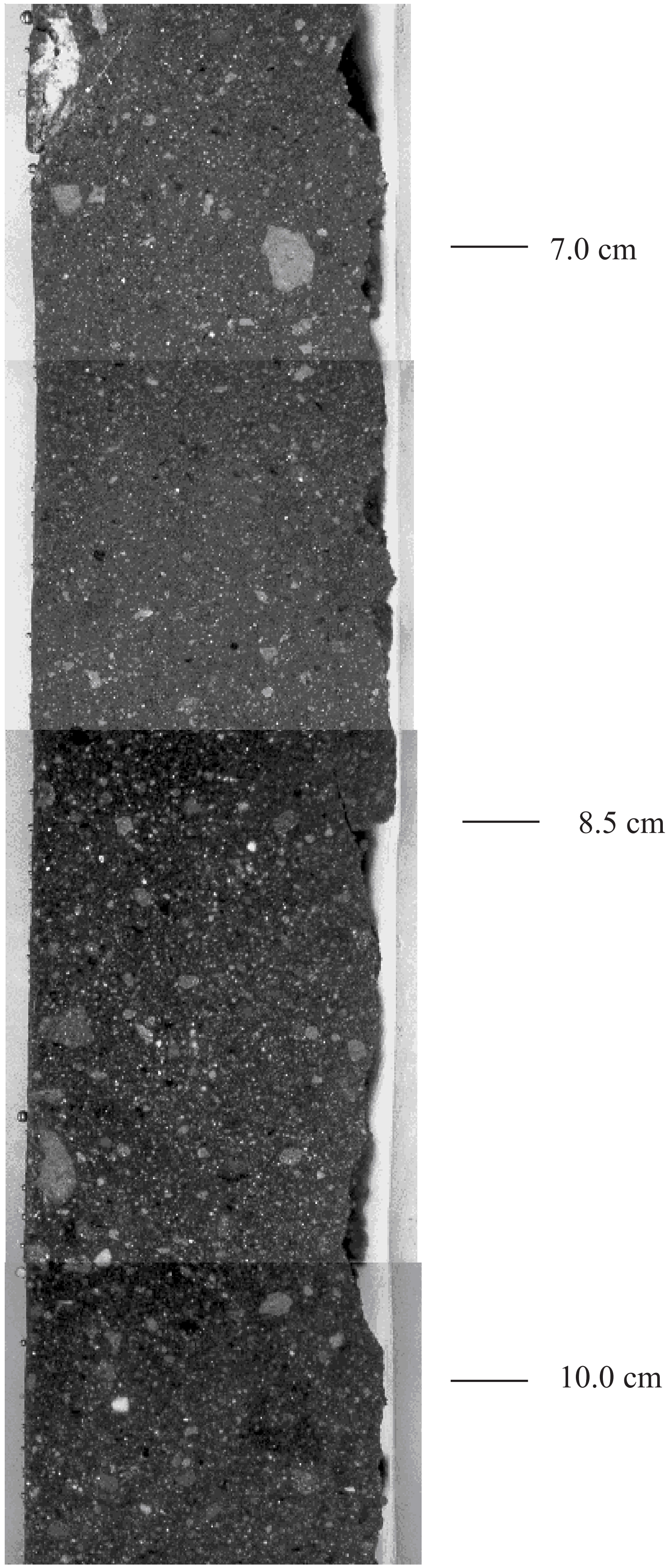
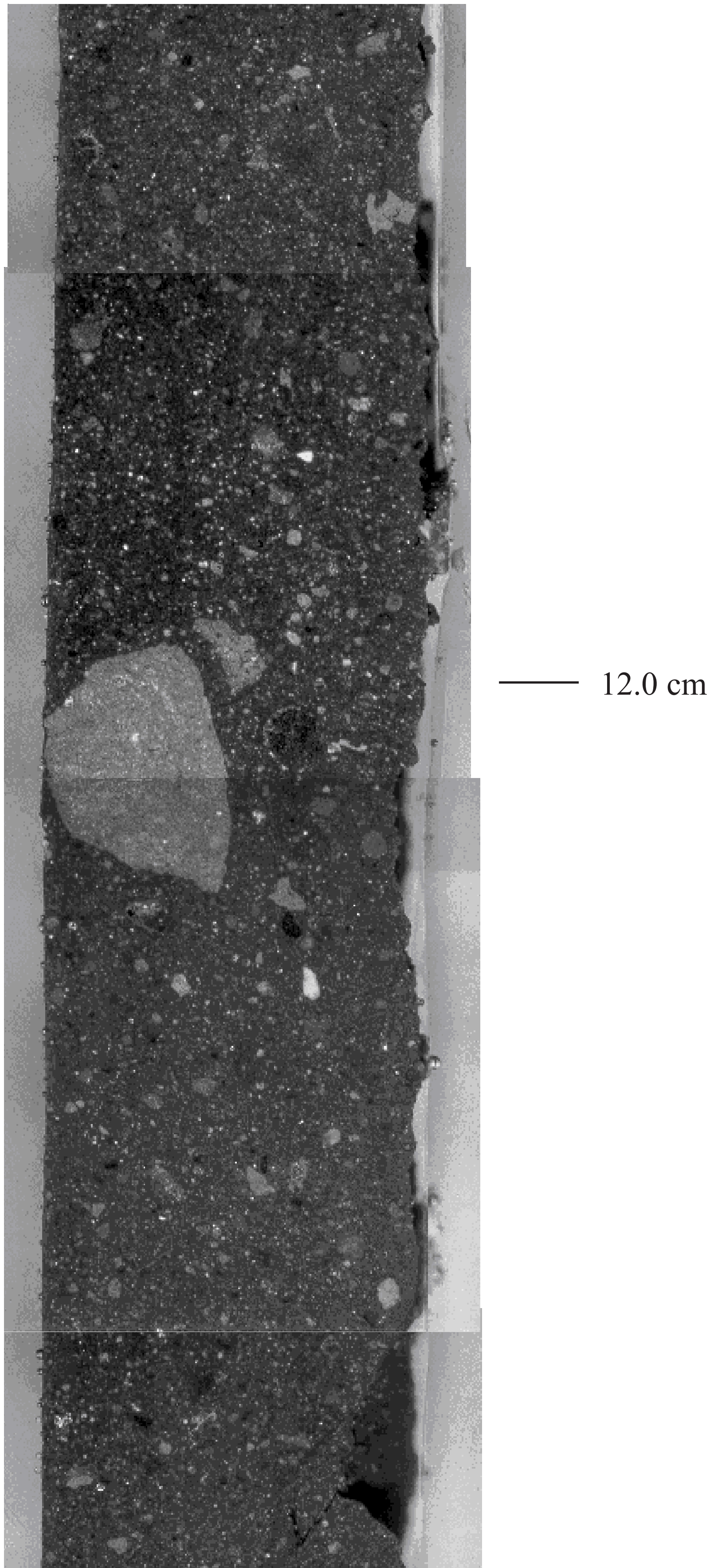
5.0 cm
6.5 cm


7.0 cm
8.5 cm
10.0 cm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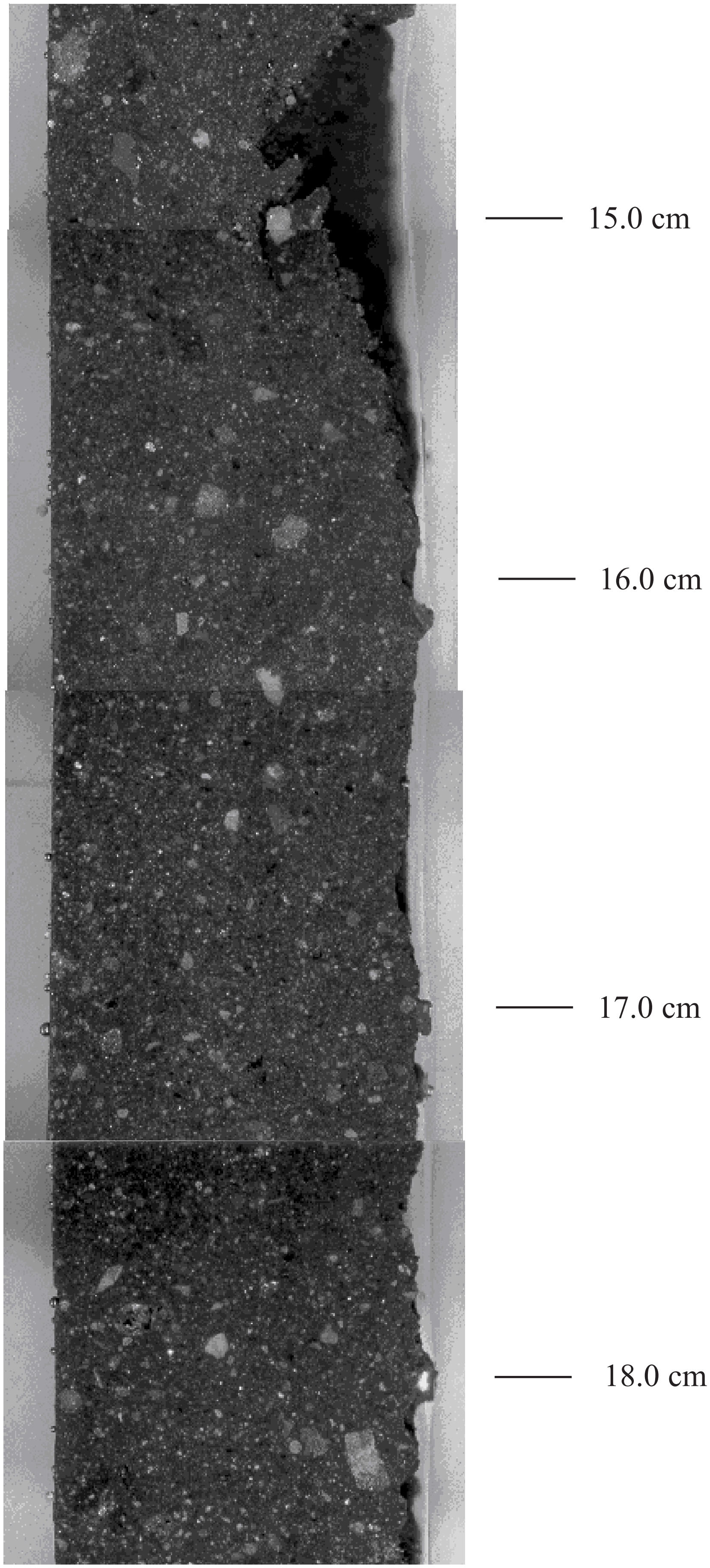
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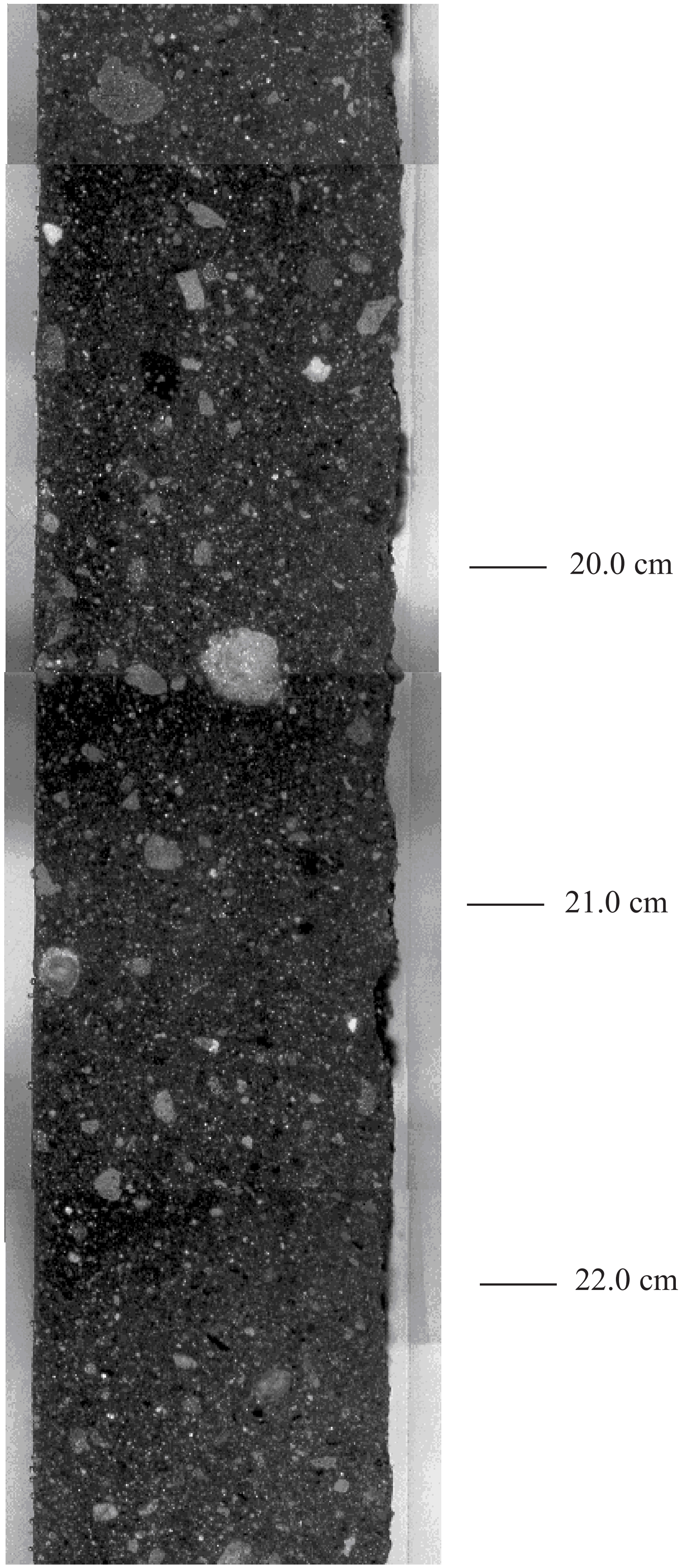

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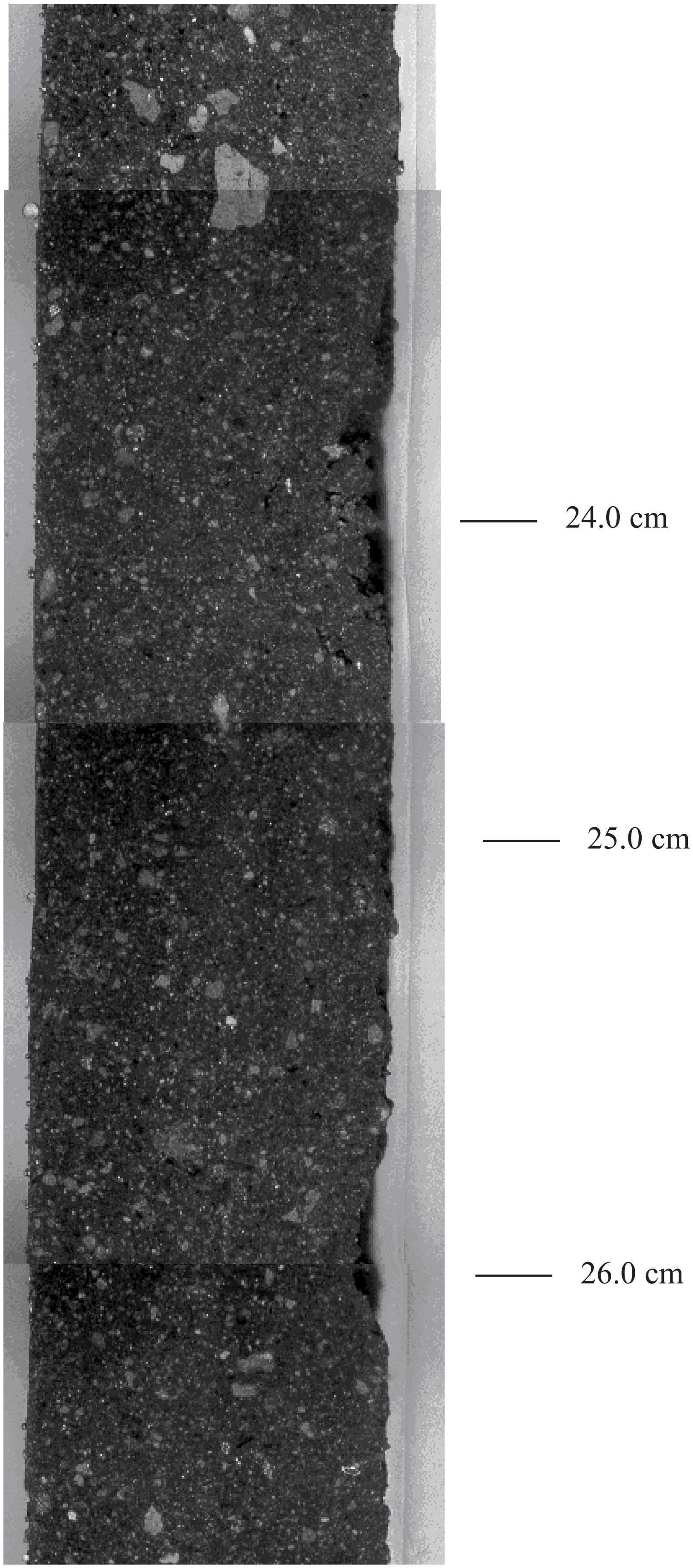
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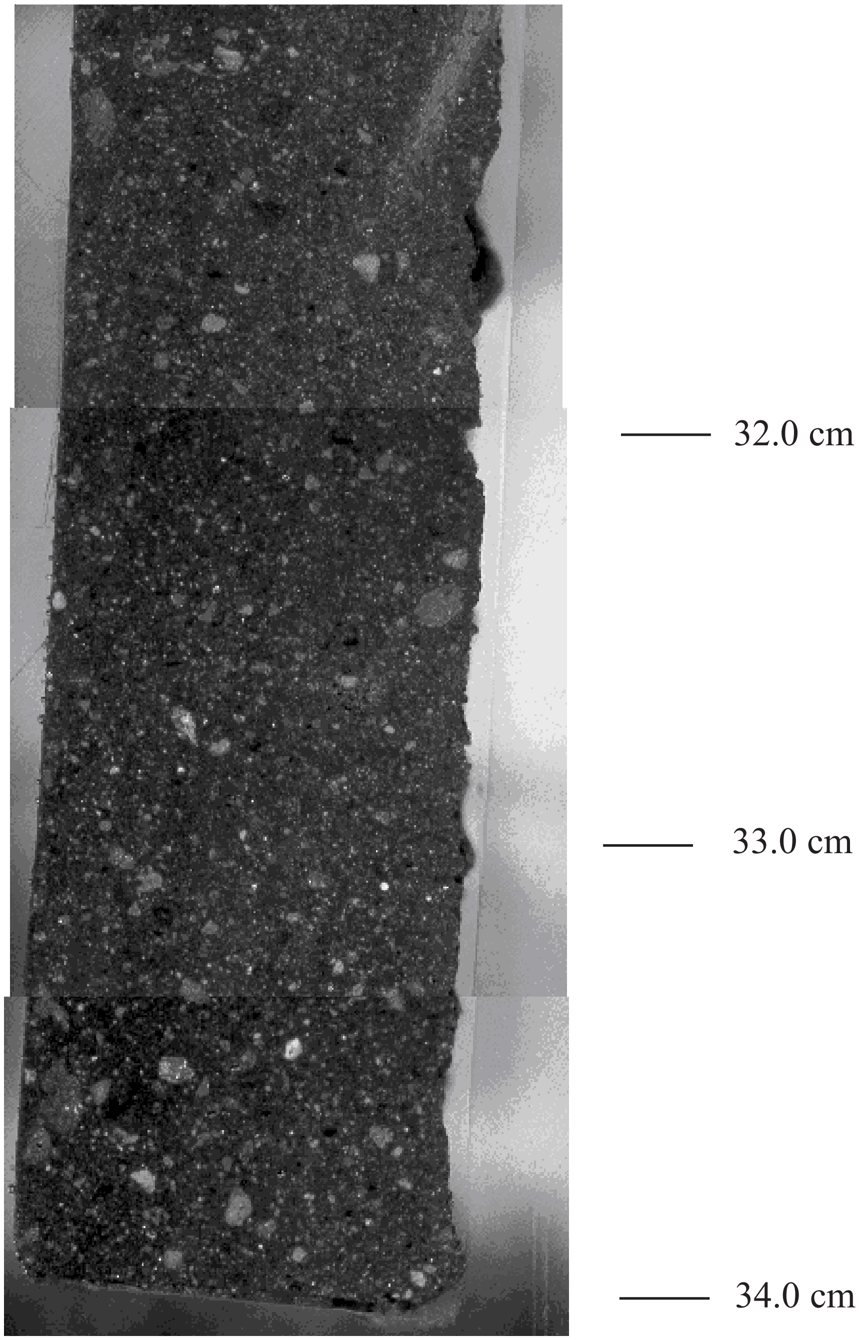

bottom of double drive tube