APPENDIX I
TOTAL ARTIFACT COUNTS FOR SITE 7K-C-360, DOVER DOWNS HILL A (7K-C-365A), AND DOVER DOWNS HILL B (7K-C-365B)

SITE 7K-C-360
PHASE I/II PREHISTORIC TOTAL SHEET

Flakes (cortex)	
Quartzite	90(7)
Quartz	66(6)
Chert	51(3)
Jasper	111(35)
Rhyolite	1
Argillite	5
Ironstone	1
Chalcedony	48(5)
Other	1
Utilized Flakes	
Quartzite	1
Jasper	2(1)
Chalcedony	1(1)
Flake Tools	
Quartz	1
Chert	2(2)
Jasper	2(2)
Chalcedony	1(1)
Archaic Points	
Jasper	2
Woodland I Points	
Jasper	1
Miscellaneous	
Chert	1(1)
Shatter	
Quartzite	1
Quartz	2(1)
Cores	
Quartzite	2
Quartz	3(3)
Jasper	4(2)
Fire-cracked Rock	96

APPENDIX I (cont.):
SITE 7K-C-360
PHASE III PREHISTORIC TOTAL SHEET

Flakes (cortex)	
quartzite	316(67)
quartz	419(80)
chert	265(76)
jasper	719(299)
chalcedony	150(28)
rhyolite	26
argillite	29
other	6(1)
Utilized Flakes (cortex)	
quartzite	6(4)
quartz	8(4)
chert	9(5)
jasper	22(16)
chalcedony	8(6)
rhyolite	1
Flake Tools (cortex)	
quartzite	2(1)
quartz	4(4)
chert	11(6)
jasper	16(11)
calcedony	3(1)
Archaic Points	
chert	1
jasper	2
Woodland I Points	
quartzite	1
chert	1
jasper	6
chalcedony	1
argillite	5
rhyolite	1
Other Bifaces (cortex)	
quartz	2
quartzite	2
chert	3(1)
jasper	1
argillite	2
rhyolite	1
ironstone	1
Fire-Cracked Rock	
count	471
weight	34,984.5 g
ESBR (cortex)	
quartzite	1
quartz	1
chert	1
jasper	6(5)
ironstone	1
LSBR (cortex)	
quartzite	1
chert	1
jasper	5(3)
rhyolite	1
Miscellaneous Stone Tools (cortex)	
quartzite	2(1)
quartz	1(1)
jasper	2(1)
Shatter (cortex)	
quartzite	17(2)
quartz	52(15)
jasper	2(1)
Cores (cortex)	
quartzite	2(2)
quartz	9(6)
chert	2(1)
jasper	13(10)
chalcedony	2(2)
argillite	1
Groundstone Tools	
hammerstones	4
hammerstone frag	3
quartzite frag	1
broken rock with cortex	1
Other	
bone frag	1
steatite frag (weight 108g)	1
charcoal sample	2
charred nut half	1
Historic	3

APPENDIX I (cont.):
DOVER DOWNS SITE, HILL A (7K-C-365A)
PHASE I/II PREHISTORIC TOTALS SHEET

Flakes (cortex)	
Quartzite	183(23)
Quartz	251(37)
Chert	291(56)
Jasper	659(210)
Rhyolite	45
Argillite	11
Chalcedony	33(1)
Other	3
Utilized Flakes	
Quartzite	2(2)
Quartz	3(1)
Chert	10(5)
Jasper	36(16)
Chalcedony	6(1)
Flake Tools	
Quartzite	1
Chert	3(3)
Jasper	5(4)
Paleo-Indian Points	
Rhyolite	1
Archaic	
Jasper	2
Woodland I Points	
Quartzite	2
Quartz	1
Chert	2
Jasper	5(2)
Argillite	3
Chalcedony	1
ESBR	
Quartzite	1
LSBR	
Quartz	1
Jasper	1
Other Bifaces	
Quartzite	1
Quartz	6(2)
Chert	2
Jasper	11(1)
Miscellaneous Stone Tools	
Quartzite	1(1)
Quartz	2
Chalcedony	1
Shatter	
Quartzite	1
Quartz	6
Chert	1(1)
Jasper	3(2)
Cores	
Quartzite	3(2)
Quartz	11(6)
Chert	6(6)
Jasper	10(1)
Groundstone Tools	2
Fire-cracked Rock	67
Prehistoric Ceramics	
Wolf Neck	4
Minguannan	28
Killens	1
Unidentifiable Ceramics	
Other unid.	18

APPENDIX I (cont.): DOVER DOWNS SITE, HILL A (7K-C-365A) PHASE III PREHISTORIC TOTAL TOTALS FOR SURFACE, FEATURES, AND UNITS

	SURFACE	FEA'S	NORTH UNITS	SOUTH UNITS
Flakes (cortex)				
quartzite	--	5(1)	20(1)	583(118)
quartz	2(1)	6	73(21)	418(75)
chert	1	--	15(7)	286(134)
jasper	2	20(6)	87(38)	1099(525)
rhyolite	--	-	1	39
argillite	--	--	3	29
ironstone	--	--	--	2(1)
chalcedony	--	2	5(1)	67(19)
other	--	1	--	7(1)
Utilized Flakes (cortex)				
quartzite	--	--	--	4(2)
quartz	--	--	1(1)	13(6)
chert	--	--	--	7(2)
jasper	--	--	1	14(10)
argillite	--	--	--	1
chalcedony	--	--	1	1
Flake Tools (cortex)				
quartzite	--	--	--	4(4)
quartz	--	--	--	9(3)
chert	--	--	1	8(4)
jasper	--	--	--	11(9)
chalcedony	--	--	--	3(1)
Archaic Points (cortex)				
chert	--	--	--	2(1)
chalcedony	--	--	--	1(1)
Woodland I Points				
quartz	--	--	--	1
chert	--	--	--	1
jasper	--	--	--	2(1)
argillite	--	--	--	5
chalcedony	--	--	1	1
Woodland II Points				
chert	--	--	--	1
ESBR (cortex)				
quartzite	--	--	--	--
quartz	--	--	1(1)	5(2)
jasper	--	--	--	--
argillite	--	--	--	1
ironstone	--	--	--	1(1)

APPENDIX I (cont.):
DOVER DOWNS SITE, HILL A (7K-C-365A)
PHASE III PREHISTORIC TOTAL TOTALS FOR SURFACE, FEATURES, AND UNITS

	SURFACE	FEA'S	NORTH UNITS	SOUTH UNITS
LSBR (cortex)				
quartz	--	--	--	3
jasper	--	--	1(1)	3(3)
rhyolite	--	--	--	1
argillite	--	--	--	1
chalcedony	--	--	--	1(1)
Other Bifaces (cortex)				
quartz	--	--	--	3(1)
jasper	--	--	2	6(2)
argillite	--	--	--	1
Miscellaneous Stone Tools				
quartz	--	--	--	2(2)
jasper	--	--	--	5(4)
Shatter (cortex)				
quartzite	--	--	1	9
quartz	--	--	5(2)	39(4)
chert	--	--	--	2
jasper	--	1	1	11(1)
Cores (cortex)				
quartzite	--	--	--	2
quartz	--	--	1(1)	3(2)
chert	--	--	1(1)	3(3)
jasper	--	--	2(1)	4(3)
chalcedony	--	--	--	1(1)
Fire-Cracked	2	--	3	60
Rock (ct. & wt.)	53g	--	241g	3414g

APPENDIX I (cont.): DOVER DOWNS SITE, HILL B (7K-C-365B) PHASE I/II PREHISTORIC TOTALS SHEET

Flakes (cortex)	
quartzite	6893(103)
quartz	327(48)
chert	95(26)
jasper	260(58)
chalcedony	34(17)
ironstone	6(4)
argillite	1
other	6
Utilized Flakes (cortex)	
quartzite	5(1)
quartz	1(1)
chert	4(2)
jasper	3(1)
chalcedony	1(1)
Flake Tools (cortex)	
quartz	1
chert	1
ironstone	1(1)
argillite	1
Woodland I Points	
quartzite	3
jasper	1
ironstone	1
argillite	1
Woodland II Points	
chert	1
jasper	1
Other Bifaces (cortex)	
quartzite	4
quartz	2
chert	2
jasper	1
argillite	1
Fire-Cracked Rock	
count	179
weight	11,264g
ESBR (cortex)	
chert	1
jasper	1(1)
chalcedony	1(1)
LSBR (cortex)	
jasper	1(1)
Miscellaneous Stone Tools	
jasper	1
Cores (cortex)	
quartzite	19(7)
chert	2(2)
jasper	2(2)
chalcedony	1(1)
Stone Bowls	
steatite frag	7
Groundstone Tools	
hammerstone frag	2

The complete artifact counts for all three sites are available upon request:

Delaware Department of Transportation
Location and Environmental Studies
P.O. Box 778
Dover, DE 19903 (302) 739-3826

University of Delaware Center for Archaeological Research
101 Ewing Hall
Newark, DE 19716
(302) 831-1193

APPENDIX II
METHODS OF ATTRIBUTE ANALYSIS OF DEBITAGE

The purpose of this appendix is to outline and describe the methods used to analyze the debitage from Site 7K-C-360 and the Dover Downs sites. These methods are identical to the analyses performed on the Paradise Lane Site (Riley, Custer, and Hoseth n.d.). The main goal of the analysis is to determine the source of the debitage, particularly to see if it was derived from bifaces or from cores. This appendix will first outline the theoretical basis for studying the question of the bifacial or unifacial core origin of flakes. Next, it will describe the flake attributes used to study the debitage with respect to its origin. Finally, a series of base line studies of flakes of known bifacial or unifacial origin will be presented to show the validity of the research methods.

THEORETICAL BACKGROUND

It is important to know whether debitage was derived from bifaces or from unifacial prepared, or amorphous, cores for a number of reasons. At the most basic level, organization of lithic technologies and patterns of lithic resource use are closely linked to settlement patterns and adaptations in various ways. Gardner's (1974, 1977, 1989, 1990) analyses of Paleo-Indian lithic technologies and lithic resource use are some of the first of these studies to be undertaken in the Middle Atlantic and recent studies have more closely analyzed the general trends noted by Gardner (eg. - Custer, Cavallo, and Stewart 1983; Stewart 1990). Other more generalized studies (eg. Kuhn 1989; Bamforth 1986; Binford 1977; Bleed 1986; Goodyear 1979; Kelly 1988; Parry and Kelly 1987; Shott 1989; Torrence 1987; White and Modjeska 1978; Wiant and Hassen 1985; and Magne 1985) have addressed similar issues.

Most of these studies have shown that factors such as settlement mobility, lithic resource availability, and the situational contingency of lithic tool use all play a role in determining how lithic technologies are organized, particularly the use of curated biface and prepared cores versus the expedient use of cores. For example, highly mobile groups who frequent areas where lithic resources are scarce have been seen to use carefully curated stone tool kits consisting of bifaces and prepared cores. On the other hand, less mobile groups in areas of readily available lithic raw materials will tend to make expedient use of quickly prepared amorphous cores. And, in some cases, a single group will alter its resource use based strictly on the availability of raw materials. For example, Paleo-Indian groups in the Shenandoah Valley of Virginia made and used carefully prepared tool kits based on bifaces and prepared cores when they were traveling away from the major quarry sources of jasper near the western margin of the Blue Ridge mountains (Gardner 1989; Verrey 1986). However, at hunting and processing sites close to the quarry sites, they expediently used a variety of amorphous cores (Carr 1986). In sum, it can be very useful to know whether an assemblage of debitage was derived from bifaces or cores in order to determine if the prehistoric groups who inhabited a site were focusing their lithic technologies on bifaces or cores.

When considering the lithic technologies of prehistoric groups of the Delmarva Peninsula, it should be noted that numerous studies of lithic technologies have shown that there is a large amount of variability in the use of bifaces or unifacial cores, as portable tool kits. For example, a close analysis of late Paleo-Indian/Early Archaic tool kits from central Eastern Shore of Maryland (Lowery and Custer 1990) has shown that these early groups made extensive use of bifaces as the central element of their transported tool kit during part of their journeys across the landscapes of the Delmarva Peninsula, where lithic resources were at a premium. This use of bifaces has been seen as one reason for a focused use of cryptocrystalline materials (Goodyear 1979; Custer 1989:119). However, when their transported, or curated (Binford 1979) tool kits were depleted, they seem to have focused more on unifacial cores (Lowery 1989) procured and produced on an expedient, or as-needed basis. In contrast, numerous studies of lithic technologies of later groups (eg. - Custer and Bachman 1986; Custer 1987; Custer, Watson, Hoseth, and Coleman 1988) indicate that there was a greater emphasis on cores, rather than bifaces, as sources of flakes in transported and curated tool kits during the Woodland I Period when levels of residential mobility were somewhat lower than at earlier times.

Studies of lithic technologies of northern Delaware, have shown other sources of variability in the composition of stone tool kits and patterns of lithic resource use. Cobble beds are quite numerous along the Fall Line and the adjacent areas of the High Coastal Plain and these locales are important sources of secondary raw materials which are suitable for the manufacture of stone tools (Custer and Galasso 1980). At the same time, high quality primary cryptocrystalline lithic resources are available from the Delaware Chalcedony Complex (Custer, Ward and Watson 1986) which is located just south of the Fall Line in western New Castle County, Delaware, and eastern Cecil County, Maryland. All of these sources of lithic raw materials were used by the prehistoric inhabitants of northern Delaware and the varieties of uses seem to be greatest during the Woodland I Period. Some groups seem to be making use of secondary cobble resources for both bifaces and cores, although cobble resources seem to be more commonly used for cores (eg. - Custer 1987; Custer and Bachman 1986; Custer, Sprinkle, Flora, and Stiner 1981). On the other hand, some groups seem to have transported large cores of cryptocrystalline jasper and used them as a source for flake tools (eg. - Custer, Watson, Hoseth, and Coleman 1988).

Because the tools and debitage deposited at a site by its prehistoric inhabitants reflect the lithic materials which they had with them, or could obtain locally at the site, and because curated lithic materials reflect immediately prior visits to quarry sites or other lithic source locations, we can understand prehistoric groups movement patterns by comparing the range of lithic resources used at a site with the locally available materials. Furthermore, if we can determine whether the flakes were derived from bifaces, prepared cores, or amorphous expediently-manufactured cores, we can understand how prehistoric groups were transporting and using lithic resources.

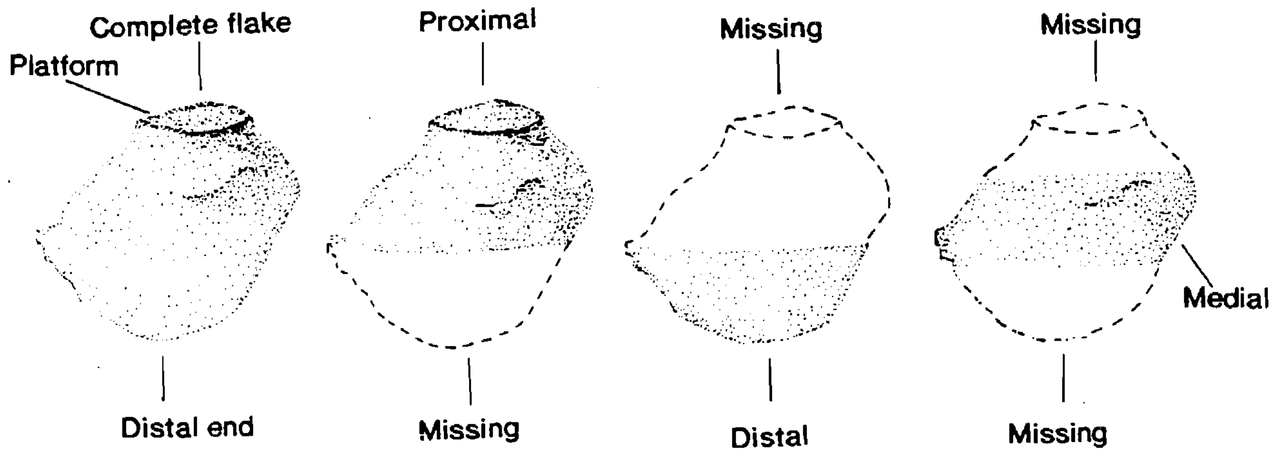
Prior research (Watson and Custer 1990a) has shown that there are important regional differences in lithic transport and use in the central Middle Atlantic region that can reveal much about their movement patterns, settlement mobility, and patterns of organization of lithic technologies. In the central and southern New Jersey Coastal Plain and the central Delaware region, particularly the St. Jones and Murderkill drainages, lithic resource use during early Woodland I times seems to be focused on the use of argillite and rhyolite for bifaces and cryptocrystalline cobble cores for flake tools. In contrast, contemporary groups of the Fall Line Zone and High Coastal Plain of Delaware have a very different and highly variable technological organization based on a use of primary jasper and cherts for both large cores and bifaces, cobble resources for both cores and bifaces, and some ironstone, argillite, and rhyolite for bifaces. These lithic resource patterns are so very different that they might be indicators of varied ethnic groups using different territories, or they might be indicative of the incredible variability of lithic resource use patterns within a single social group. Application of the research methods described in this appendix will help us to better understand how these prehistoric groups were using these different lithic resources at different locations across the landscape.

FLAKE ATTRIBUTES

The attributes used in this analysis were selected from a variety of debitage attributes described in the work of Verrey (1986), Magne (1981, 1985), and Gunn and Mahula (1977), and are listed below:

1) Flake Type (complete, proximal, medial, or distal) (Figure 137; Plate 8). This variable measures the degree of breakage of the flake assemblage and is useful because biface reduction

FIGURE 137
Flake Type



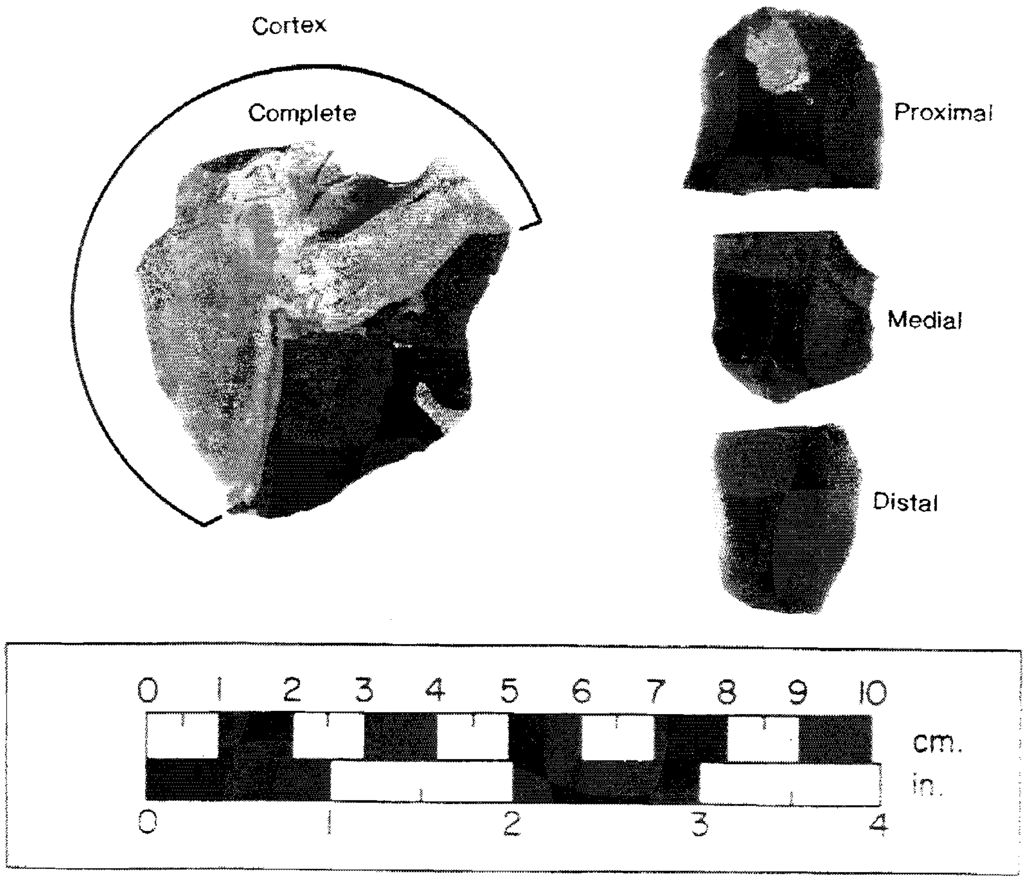
tends to produce more broken flakes than does production of flakes from cores. Biface reduction produces more broken flakes because during biface reduction the emphasis is on effectively reducing the thickness of the biface (Callahan 1979) and the production of flakes takes on a more secondary role. In contrast, core reduction emphasizes the flake and fewer broken flakes result.

2) Presence or Absence of Cortex (Plate 8). This attribute helps to determine if the flake was derived from a primary or secondary raw material source.

3) Flake Size (<2cm, >2cm-<5cm, >5cm)
(<10mm, >10mm-<15mm, >15mm-<20mm, >20mm-<25mm, >25mm-<30mm, >30mm-<35mm, >35mm-<40mm, >40mm-<45mm, >45mm)

4) Number of Flake Scars on the Flake's Distal Surface (Plate 9). This variable was recorded because flakes produced from biface reduction tend to have more remnant flake scars on their dorsal surface than do flakes derived from cores due to earlier episodes of bifacial reduction.

PLATE 8
Flake Types

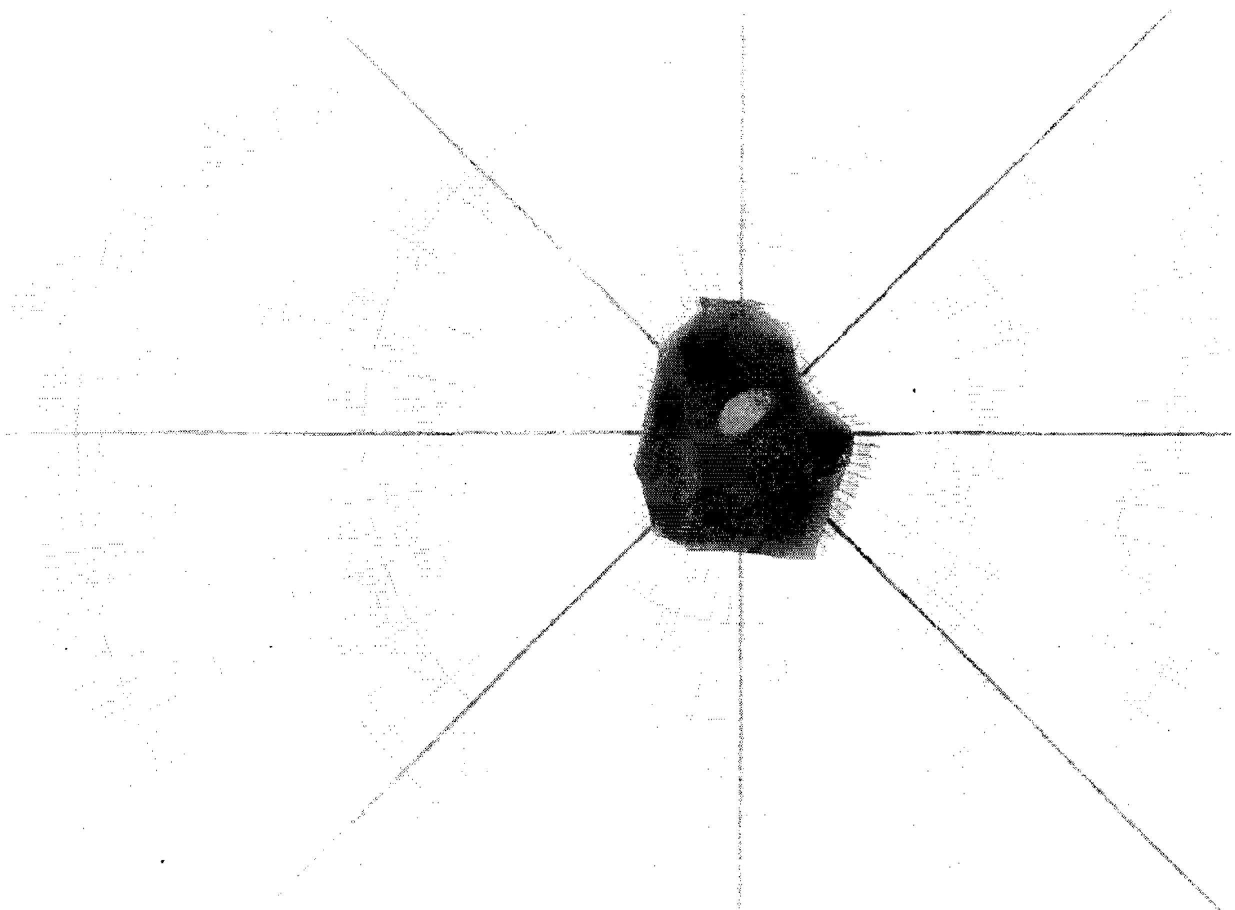


5) Number of Directions from which the Flake Scars Were Struck (Plate 9). This variable is also related to the identification of flakes produced from bifacial reduction, as opposed to cores, because flakes from bifacial reduction will show a greater number of flake directions on their dorsal surfaces due to earlier episodes of biface reduction.

6) Shape of the Flake Platform (round, triangular, flat) (Figure 138; Plate 10). Gunn and Mahula (1977) note that flat platforms are typical of flakes struck from cores, triangular platforms are typical of biface thinning flakes, and round platforms are typical of early stage biface reduction flakes and decortication flakes.

PLATE 9

Flake Scars and Scar Directions



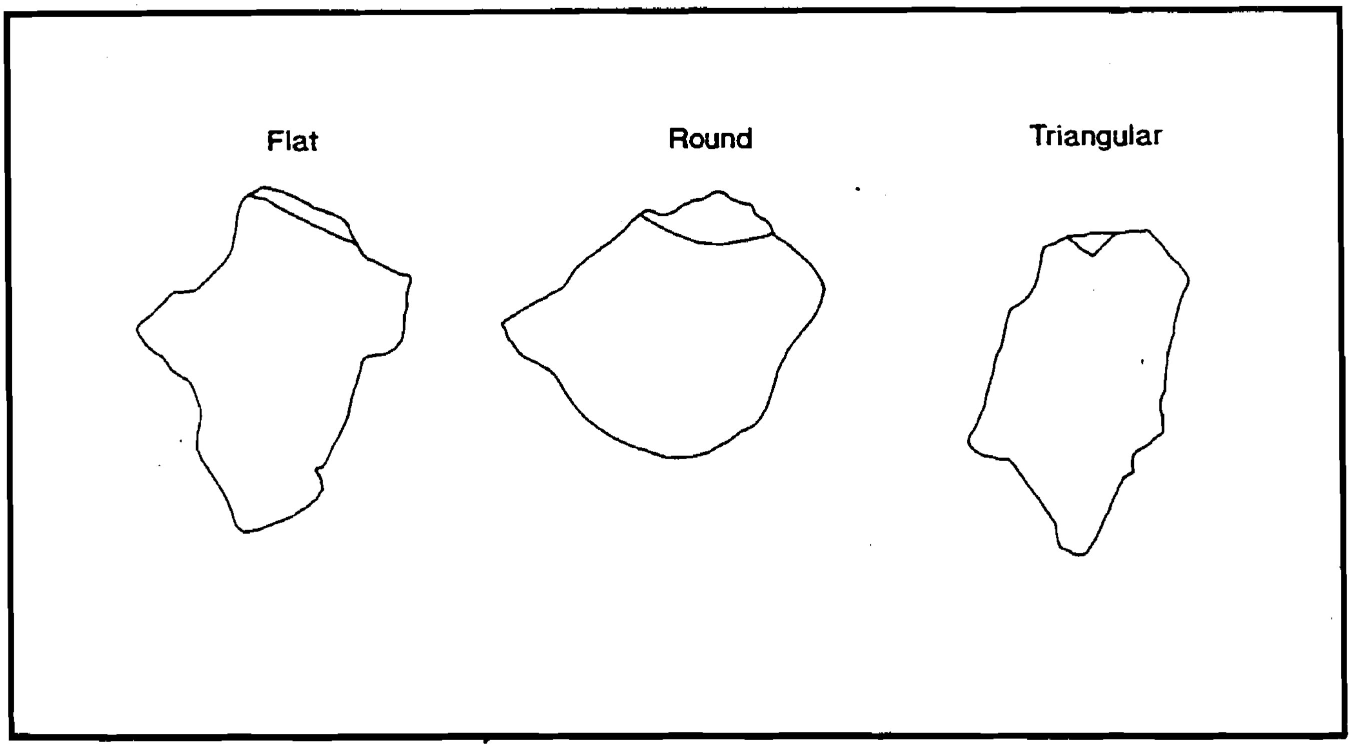
7) Presence or Absence of Remnant Biface Edges (Plate 11). This attribute is the best sign that a flake was derived from a biface rather than a core.

8) Presence or Absence of Retouch. This variable simply records whether or not the flake was retouched to have a particular edge shape.

CONTROL ANALYSES

The attributes listed above have been shown to be sensitive to the discrimination of flakes derived from bifaces from flakes removed from cores in the studies noted above especially Gunn and Mahula (1977) and Magne (1981, 1985). Nonetheless, in order to test their

FIGURE 138
Platform Shapes



validity as discriminating attributes, a series of control studies was undertaken using debitage from experimental reproductions of bifacial tools and debitage from archaeological contexts where refitting analyses confirmed the origin of flakes from either cores or bifaces. The first set of control debitage is a random sample of 100 flakes from the Fifty Site, a stratified Paleo-Indian/Early Archaic site from the Shenandoah Valley of Virginia. Refitting of the debitage (Carr 1986) from the site has shown that the flakes are primarily derived from the reduction of amorphous and blocky cores of jasper. The remaining control samples of debitage were derived from the manufacture of three bifaces by Errett Callahan. The three bifaces are depicted in Figure 139. One is an early stage biface and the other two are middle to late stage bifaces (see Callahan 1979 for a description of the stages). All of the debitage from the bifaces was saved by stage so that the samples could be divided into early and late stage debitage.

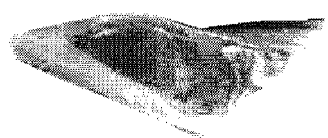
Table 51 shows the distribution of the flake attributes for each of the bifaces, the late stage biface samples combined all bifaces combined, and the core debitage from the Fifty Site. Table 52 shows the values of the test statistics for a series of comparisons of the debitage

PLATE 10

Platform Shapes

Round

Triangular



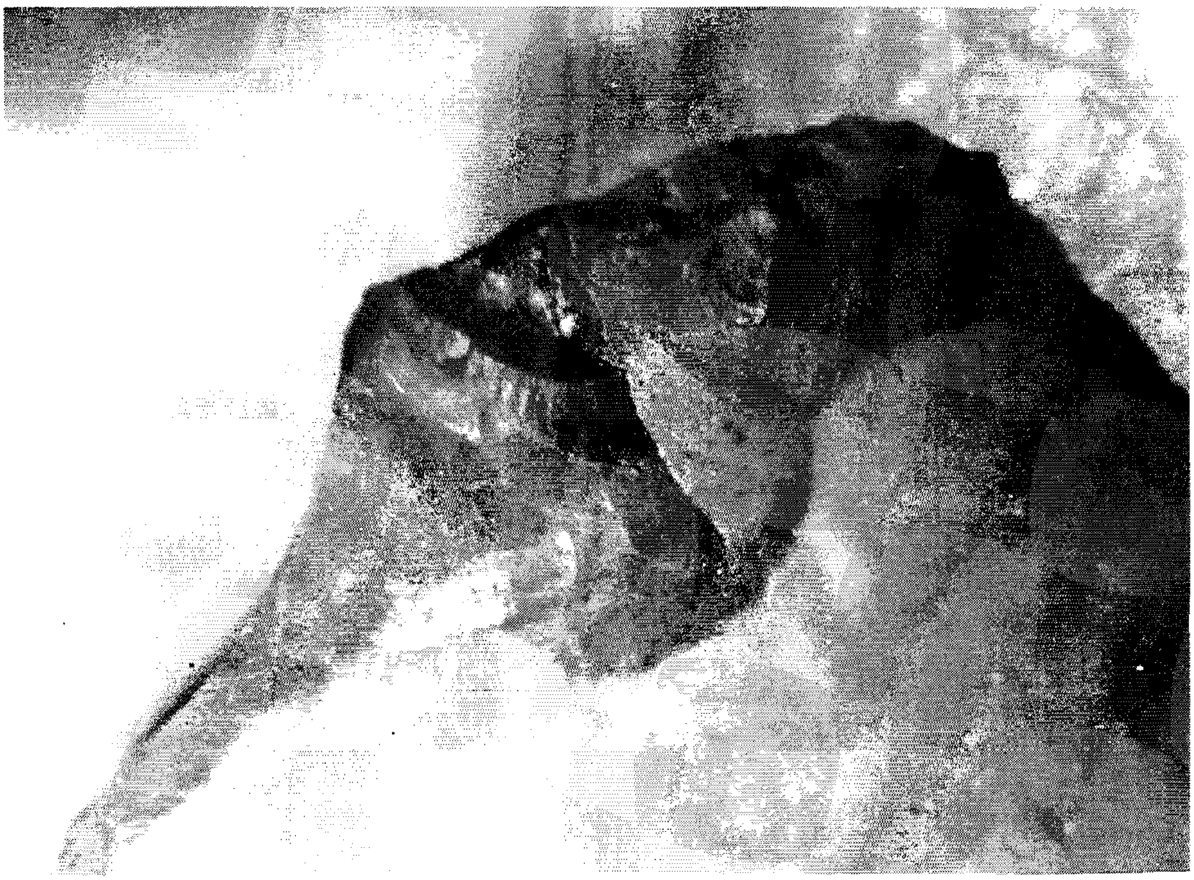
Flat

samples using difference-of-proportion and difference-of-mean tests (Parsons 1974). The first set of test statistics shows a comparison of the debitage samples from the two late stage bifaces. Some differences are noted with one of the debitage assemblages showing significantly more complete flakes, more examples of platform preparation, and more complex patterns of flake scars on the flakes' distal surfaces. However, the second two comparisons noted in Table 52 show that both late stage biface debitage assemblages are significantly different from the early stage biface. In general, there are significantly more complete flakes in the early stage assemblages, more small flakes in the later stage assemblages, more flake scars in more complex patterns among the late stage assemblages, and more triangular shaped platforms among the late stage assemblages. Because the late stage biface debitage assemblages were more like each other than they were like the early stage assemblage, these two samples were combined for analysis. A comparison of the early stage assemblage and the combined late stage sample is also noted in Table 52 and the results of comparison show the same pattern of significant differences above.

Figure 140 shows a comparison of the debitage assemblages from the core, the early stage biface, and the late stage bifaces. Test statistics from these comparisons are also noted in Table 52. With respect to flake types, the main difference between the biface and core debitage

PLATE 11

Remnant Biface Edge



assemblages is the presence of significantly more complete flakes in the core assemblage. Significant differences are also noted in flake size with more smaller flakes present in the biface assemblages. Likewise, triangular-shaped platforms are significantly more common among the biface assemblages. Remnant biface edges are significantly more common among biface assemblages, as expected, and platform preparation is significantly more common among the biface assemblages as well.

In general, the comparison of the control assemblages confirms the results of prior studies (Magne 1981, 1985; Gunn and Mahula 1977). For the most part, a debitage assemblage from biface reduction is characterized by low proportions of complete flakes, large proportions of small flakes, large proportions flakes with triangular platforms, large proportions of remnant biface edges, and many instances of platform preparation. In contrast, core reduction debitage assemblages have large proportions of complete flakes, and few instances of triangular platforms, remnant biface edges, and platform preparation. These attributes will be applied to the debitage assemblages from Sites 7NC-J-134, 7K-C-359, 7K-C-363, 7K-C-364, 7K-C-367, and 7K-D-22 discussed in this report.

FIGURE 139

Biface Production Stages

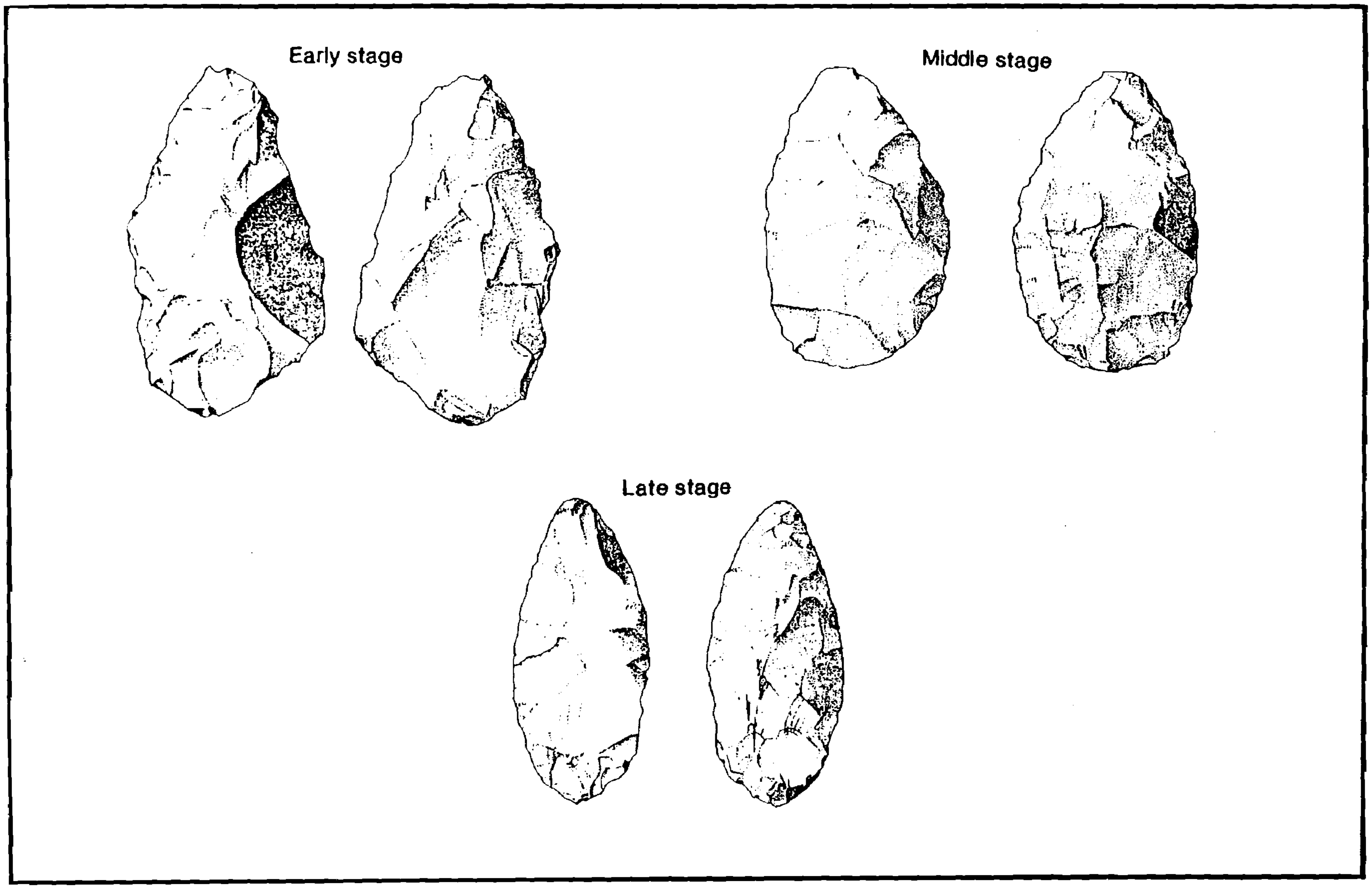


TABLE 51

DISTRIBUTION OF FLAKE ATTRIBUTES

Distribution	Callahan Early Stage Biface No.	%	Callahan Late Stage Biface 1 No.	%	Callahan Late Stage Biface 2 No.	%	All Late Stage Bifaces No.	%	All Bifaces No.	%	44WR50 Core No.	%
Flake Type												
Complete	30	(11)	6	(4)	21	(18)	27	(11)	60	(12)	63	(63)
Proximal	51	(19)	52	(38)	44	(38)	96	(38)	147	(28)	19	(19)
Medial	76	(29)	37	(27)	20	(17)	57	(22)	133	(26)	4	(4)
Distal	106	(40)	43	(31)	32	(27)	75	(29)	181	(35)	14	(14)
Cortex												
Yes	162	(61)	4	(3)	0	(0)	4	(2)	166	(32)	0	(0)
No	104	(39)	134	(97)	117	(100)	251	(98)	355	(68)	100	(100)
Size												
Large	11	(4)	1	(1)	1	(1)	2	(1)	13	(2)	5	(5)
Medium	66	(25)	25	(18)	16	(14)	41	(16)	107	(20)	46	(46)
Small	189	(71)	112	(81)	100	(85)	212	(83)	401	(78)	49	(49)
Scar Count												
Mean	1.81		2.25		2.13		2.19		2.00		1.33	
Standard Deviation	1.01		.82		.86		.84		.95		1.22	
Directions												
Mean	1.52		2.06		1.80		1.94		1.73		.73	
Standard Deviation	.81		.66		.25		.69		.78		.60	
Platform Shape												
Triangular	58	(67)	50	(91)	60	(91)	110	(91)	168	(81)	10	(10)
Round	8	(9)	5	(9)	3	(5)	8	(6)	16	(7)	37	(37)
Flat	20	(23)	0	(0)	3	(5)	3	(3)	23	(12)	35	(35)
Biface Edge												
Yes	12	(13)	17	(31)	11	(17)	28	(23)	40	(19)	3	(3)
No	77	(87)	38	(69)	55	(83)	93	(77)	170	(81)	97	(97)
Platform Preparation												
Yes	74	(90)	55	(98)	54	(82)	109	(77)	183	(88)	10	(10)
No	12	(10)	1	(2)	12	(18)	13	(23)	25	(12)	72	(72)
Number	268		141		119		260		528		100	

TABLE 52

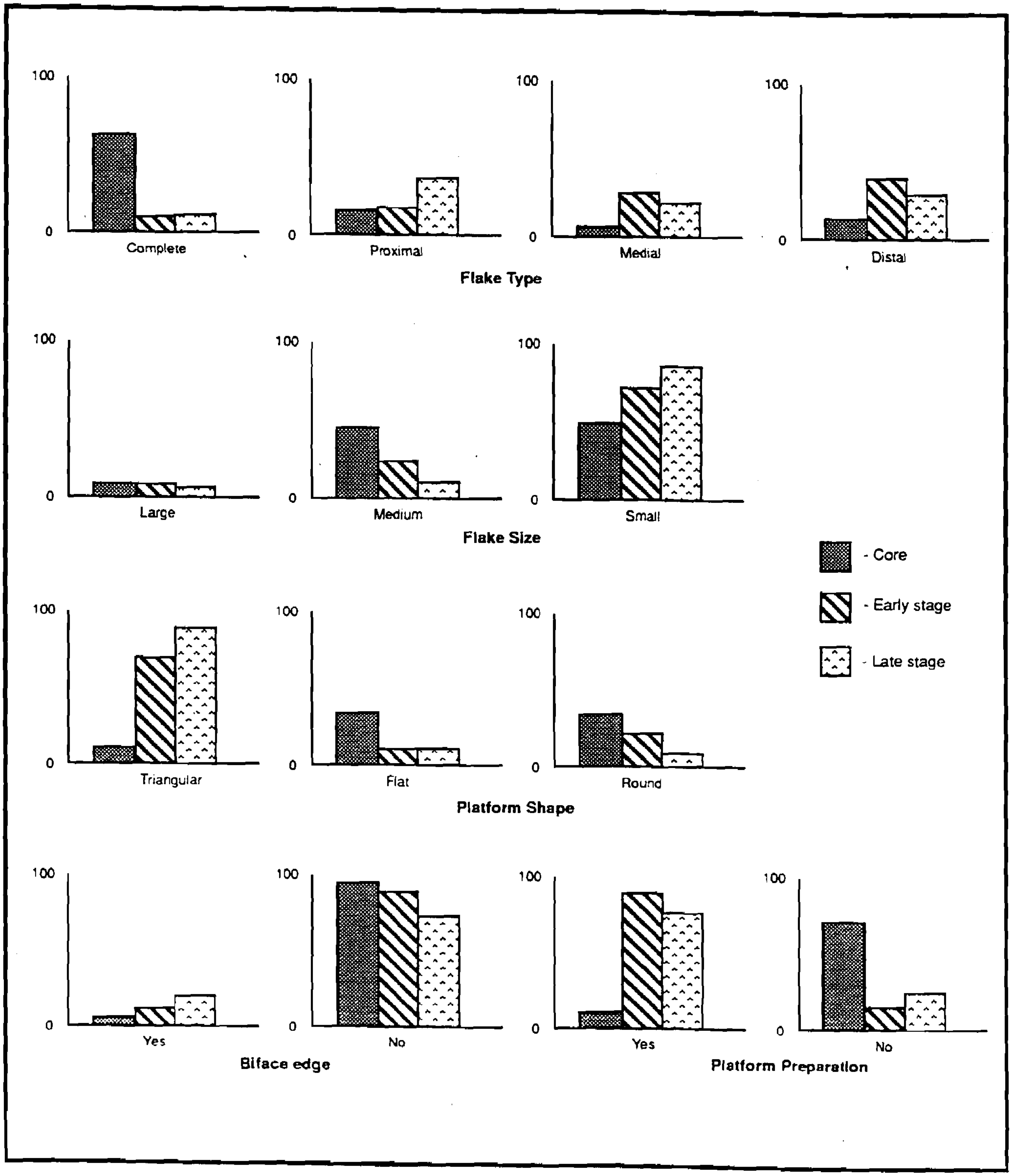
TEST STATISTICS FOR COMPARISONS

	LS1/ LS2	E/ LS1	E/ LS2	E/ LATE	44WR50/E	44WR50/L
Flake Type						
Complete	3.52*	2.34*	1.73	.29	10.06*	10.21*
Proximal	.01	3.98*	3.79*	4.61*	.08	3.37*
Medial	1.86	.44	2.44*	1.70	5.11*	4.12*
Distal	.67	1.80	2.42*	2.59*	4.76*	3.01*
Size						
Large	.11	1.91	1.69	2.45*	.34	2.56*
Medium	.96	1.52	2.45*	2.46*	3.85*	5.89*
Small	.92	2.21*	3.02*	3.27*	3.94*	6.55*
Scar Count						
Mean	1.14	4.75*	3.19*	4.69*	3.511*	6.49*
Standard Deviation	--	--	--	--	--	--
Directions						
Mean	4.32*	7.26*	5.13*	6.41*	10.16*	16.42*
Standard Deviation	--	--	--	--	--	--
Platform Shape						
Triangular	0.00	3.21*	3.44*	4.25*	8.11*	12.01*
Round	1.00	.04	1.12	.71*	4.14*	5.31*
Flat	1.60	3.86*	3.19*	4.69*	2.02*	6.63*
Biface Edge						
Yes	1.85	2.53*	.55	1.76	2.66*	2.57*
No	1.85	2.53*	.55	1.76	2.66*	2.57*
Platform Preparation						
Yes	2.92*	2.45*	.71	.72	10.39*	11.79*
No	2.92*	2.45*	.71	.72	10.39*	11.79*

* - Statistically Significant Difference

FIGURE 140

Comparison of Flake Attributes



APPENDIX III

PALEOGEOMORPHIC HISTORY OF ARCHAEOLOGICAL SITE 7K-C-360

PALEOGEOMORPHIC HISTORY OF ARCHAEOLOGICAL SITE 7K-C-360

James E. Pizzuto
Department of Geology
University of Delaware
Newark, DE 19716

June 1992

INTRODUCTION

The goal of this report is to describe the Holocene geomorphic history of Archaeological Site 7K-C-360.

DESCRIPTION OF THE STUDY AREA

The study area in located in the immediate vicinity of Archeological Site 7K-C-360, which is located approximately 4 km north northwest of Dover, Delaware. The archeological site is located on the top of a small knoll which is surrounded by several depressions (Figure 1). The depressions are seasonally inundated freshwater wetlands (primarily forested) which are drained by small, sluggish stream channels. Because these depressions probably record climatic and geomorphic events throughout the Holocene, they provided the focus for the present study. Coring and other investigations were centered in and around the largest depression located east of the archeological site (Figure 1).

METHODS

The sediments of the wetland were sampled by taking five cores (Figure 1). Two of these cores were obtained using 3" aluminum pipe and vibradrilling equipment. Vibracores were obtained following procedures described by Hoyt and Demarest (1981). The other cores were obtained using a 2.5 cm Eijelkamp hand-driven auger and a 3" bucket auger. The Eijelkamp corer was used to sample softer horizons which could be penetrated relatively easily. More compact horizons could only be sampled using the bucket auger. Hand-driven core samples were described in the field. Vibracores were returned to the lab, split, described, and sampled for subsequent analyses. All coring sites were located using a hand level, tape, and Brunton compass.

The percentages of gravel, sand, silt, and clay of selected samples were determined using methods of Folk (1974). The classification of Folk et al. (1970) was used in describing sediments. Colors were measured using the GSA Rock Color Chart (Rock Color Committee, 1991). Two sediment samples were sent to Beta Analytic, Inc. for radiocarbon dating. Dr. J. Groot of the Delaware Geological Survey performed qualitative pollen analyses on two samples.

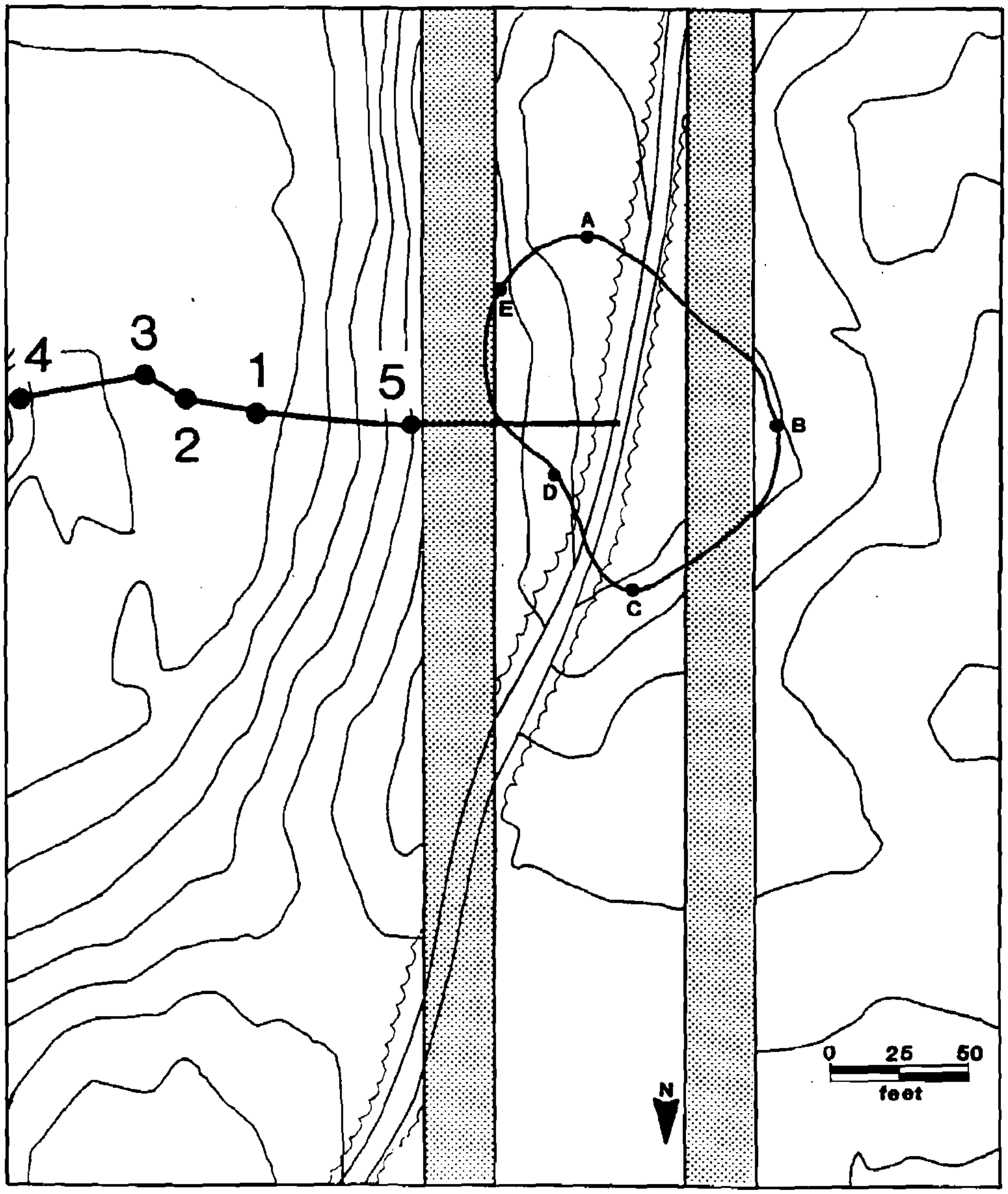


Figure 1. Locations of the Archaeological Site 7K-C-360 and cores (numbered black squares). The line of section of Figure 2 is also indicated. The contour interval is 1 ft. (0.30 m).

RESULTS

Cores penetrated up to 3 m of unconsolidated sediments (detailed graphic logs of all cores are presented in Appendix 1). These sediments may be grouped into 4 lithofacies: gravelly sand, olive gray sandy mud, olive gray muddy sand, and peat.

Gravelly Sand

The gravelly sand facies is the basal unit of the area (Figures 2, 3A, and 3B). It consists of gravelly sand, sand, with minor amount of muddy sand. Colors include grayish brown (5YR 3/2), light olive gray (5 Y 6/1), dark yellowish orange (10 YR 6/6), dark yellowish brown (10 YR 4/2).

Olive Gray Sandy Mud

The olive gray sandy mud is found in cores 360-VC-1A, 360-VC-1B, 360-DC-2A, 360-DC-2B, 360-VC-2AB, 360-VC-3A, and 360-DC-3B (Figures 2 and 4A and 4B). (DC indicates a hand-driven core, while VC indicates a vibracore. The numbers 1, 2, 3, 4, and 5 indicate locations as illustrated in Figures 1 and 2) (hand-driven cores and vibracores were often obtained at the same locations). The olive gray sandy mud facies consists of sandy mud and mud. It frequently contains laminae of fine to medium sand. Colors include olive gray (5 Y 4/1), light olive gray (5 Y 6/1), light gray (N7), with minor amounts of pale brown (5 YR 5/2). Grain size analyses (Figure 5, Table 1) indicate that the olive gray sandy mud facies consists of 61% mud and 39% sand and gravel. The 61% mud consists of 28% clay and 33% silt, while the coarser 39% consists of 38% sand and 1% gravel. A radiocarbon date from this unit (obtained from a depth of 144-154 cm from core 360-VC-1) yielded an age of 15,780 years B.P. (Table 2). Two pollen analyses from depths of 126 and 167 cm from core 360-VC-1 indicate abundant pine, spruce, and freshwater wetland plant species in the area (Appendix 2).

Olive Gray Muddy Sand

The olive gray muddy sand facies is found immediately overlying the olive gray sandy mud facies (Figures 2 and 6A and 6B). It consists of muddy sand and sandy mud with minor amounts of mud. Colors include light olive gray (5 Y 6/1), olive gray (5 Y 4/1), and brownish black (5 YR 2/1). Orange and gray mottles are common.

Peat

The peat facies overlies the olive gray muddy sand facies (Figures 2, 4A and B, and 5A and B). It consists of partially decayed leaves, roots, and pieces of wood mixed with inorganic sediment. Colors include dark yellowish brown (10 YR 4/2),

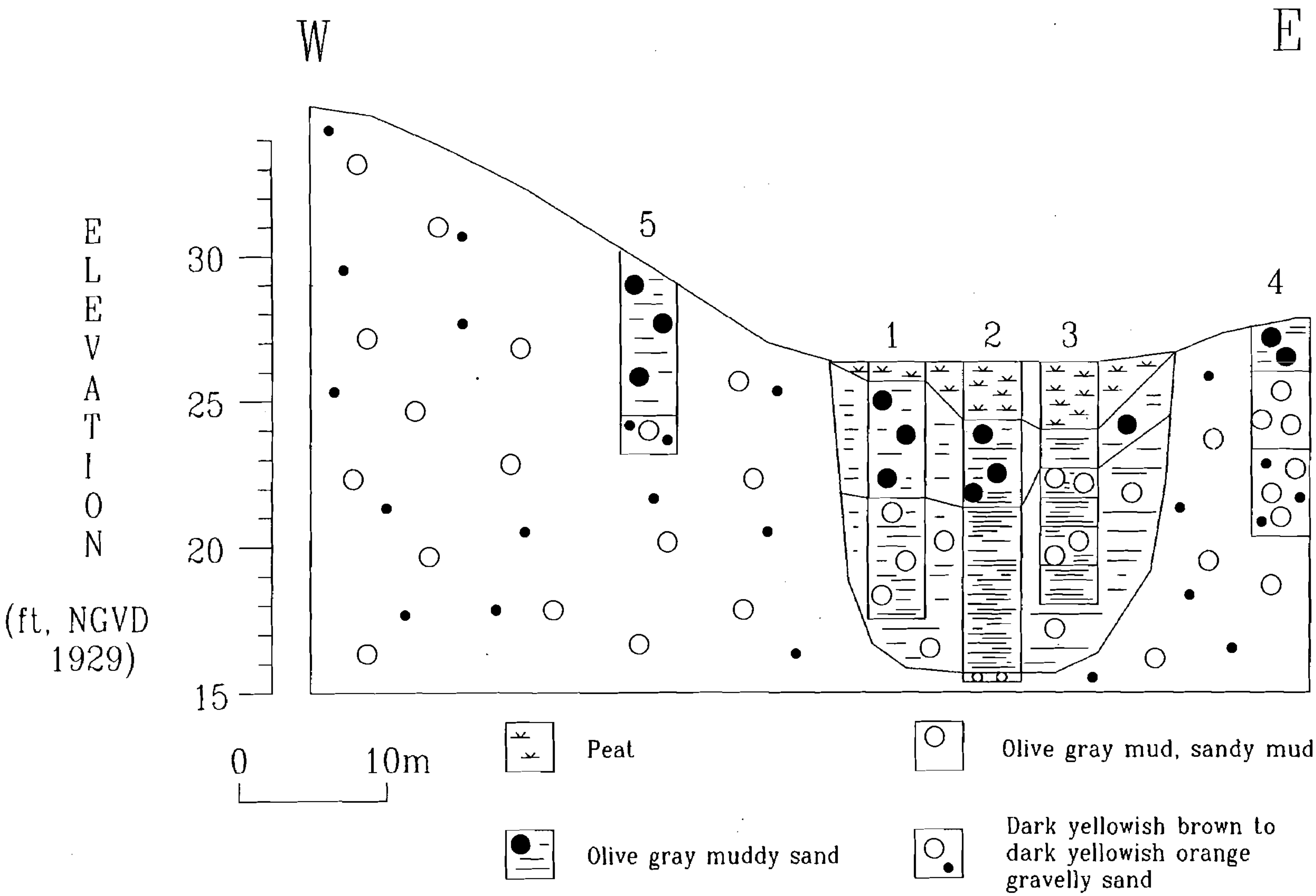


Figure 2. Geologic cross-section of the study area. The line of section is indicated in Figure 1.

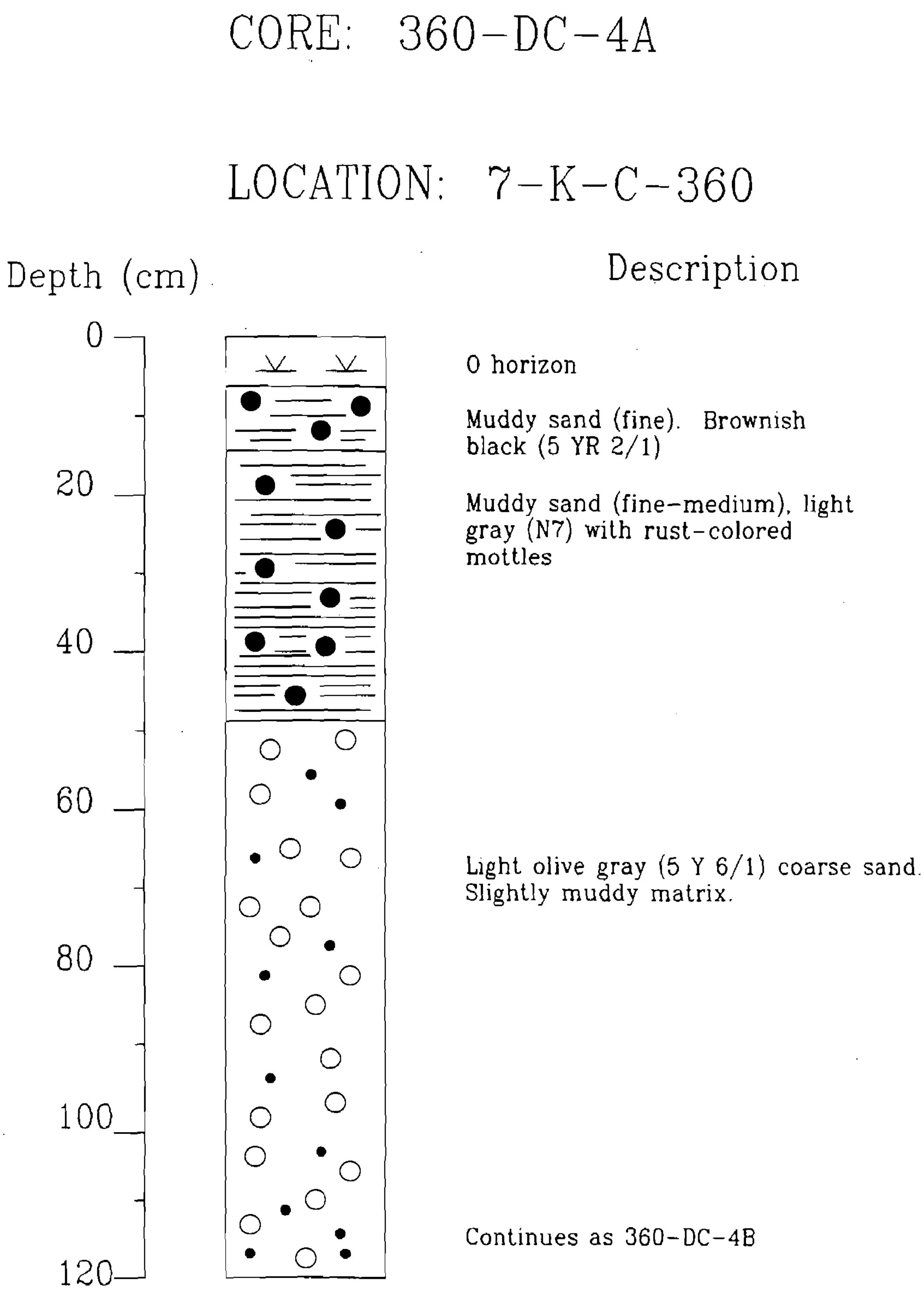
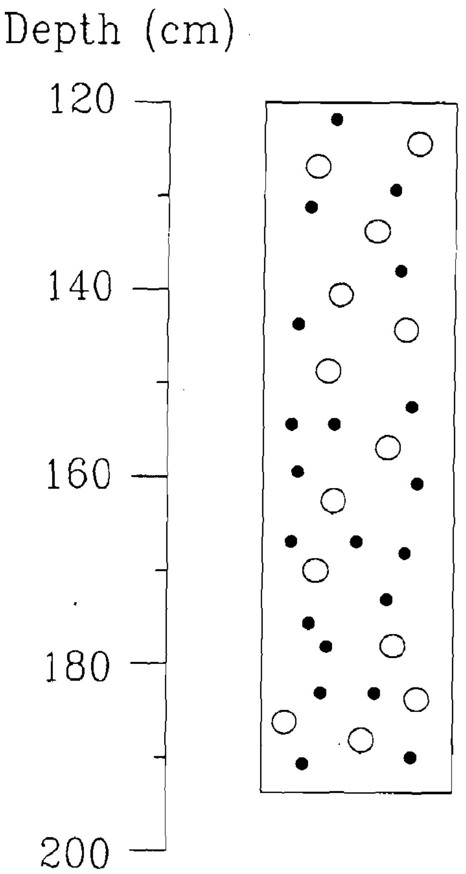


Figure 3A. Detailed lithologic characteristics of the dark yellowish orange gravelly sand facies.

CORE: 360-DC-4B

LOCATION: 7-K-C-360



Description

Gravelly sand. Gravel grains are granules. Dark yellowish brown (10 YR 4/2).

Figure 3B. Detailed lithologic characteristics of the dark yellowish orange gravelly sand facies.

CORE: 360-DC-3A

LOCATION: 7-K-C-360

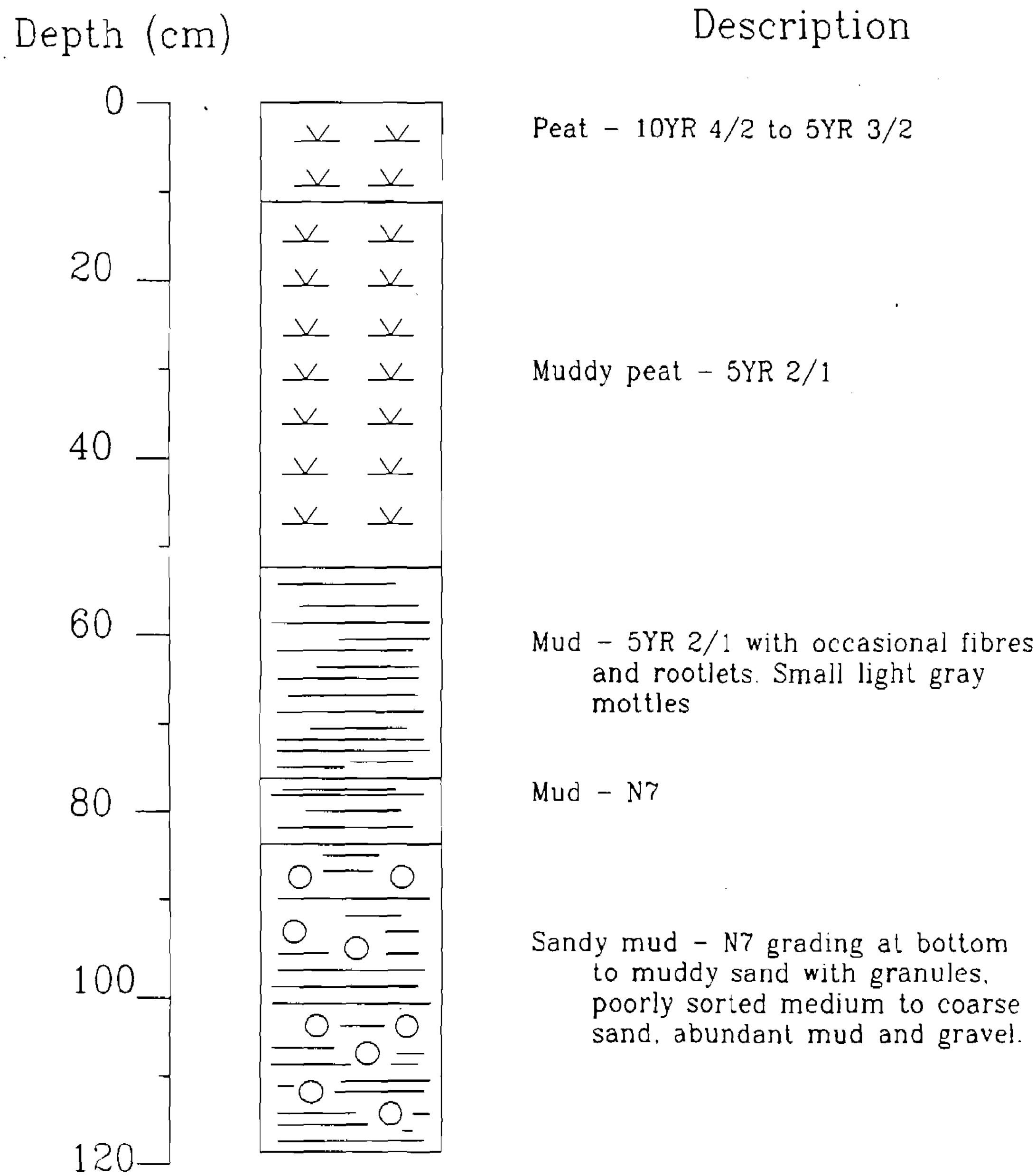


Figure 4A. Detailed lithologic characteristics of the olive gray sandy mud facies (82-120 cm). The olive gray muddy sand facies (52-82 cm) and the peat facies (0-52 cm) are also present.

CORE: 360-DC-3B

LOCATION: 7-K-C-360

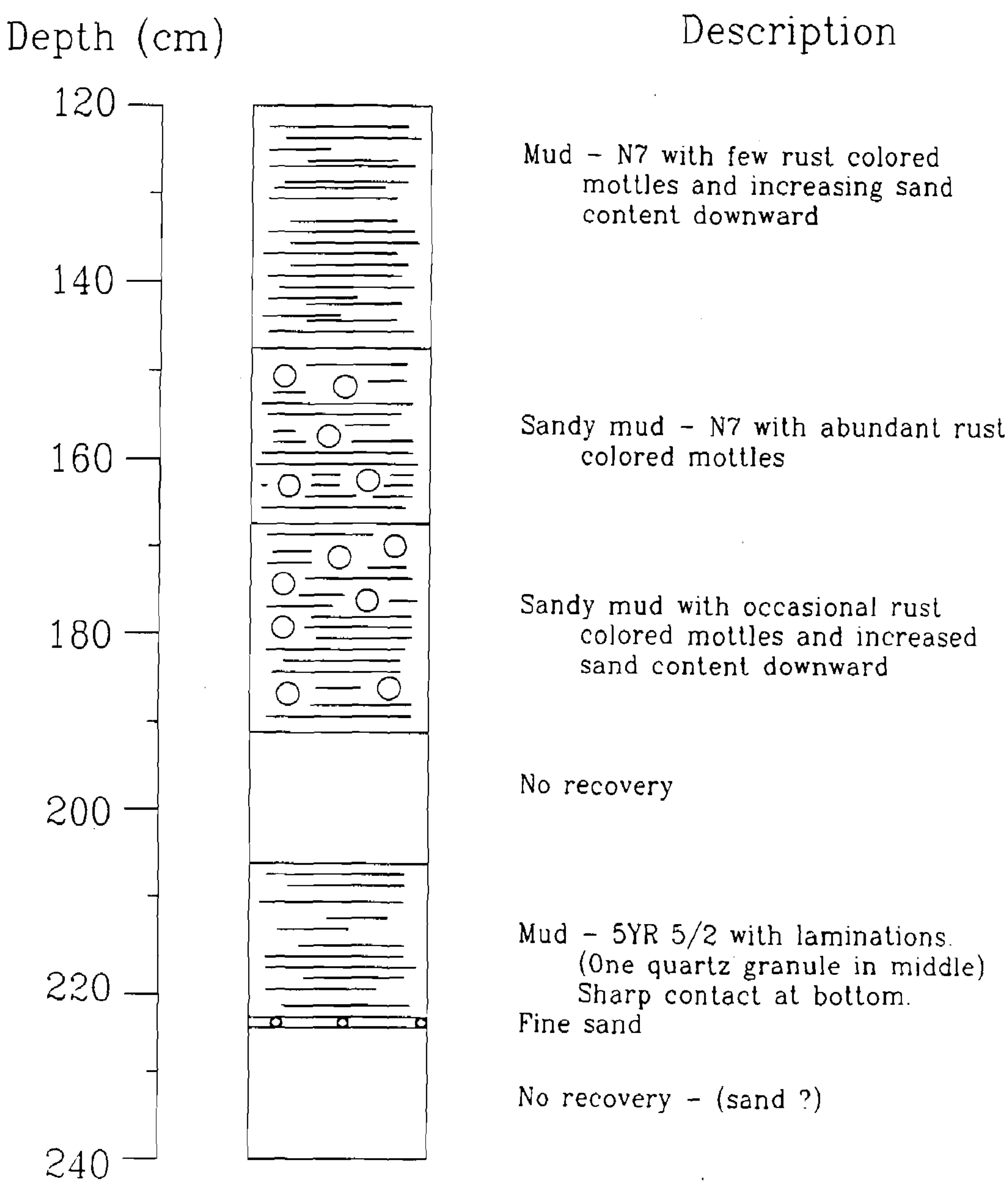


Figure 4B. Detailed lithologic characteristics of the olive gray sandy mud facies.

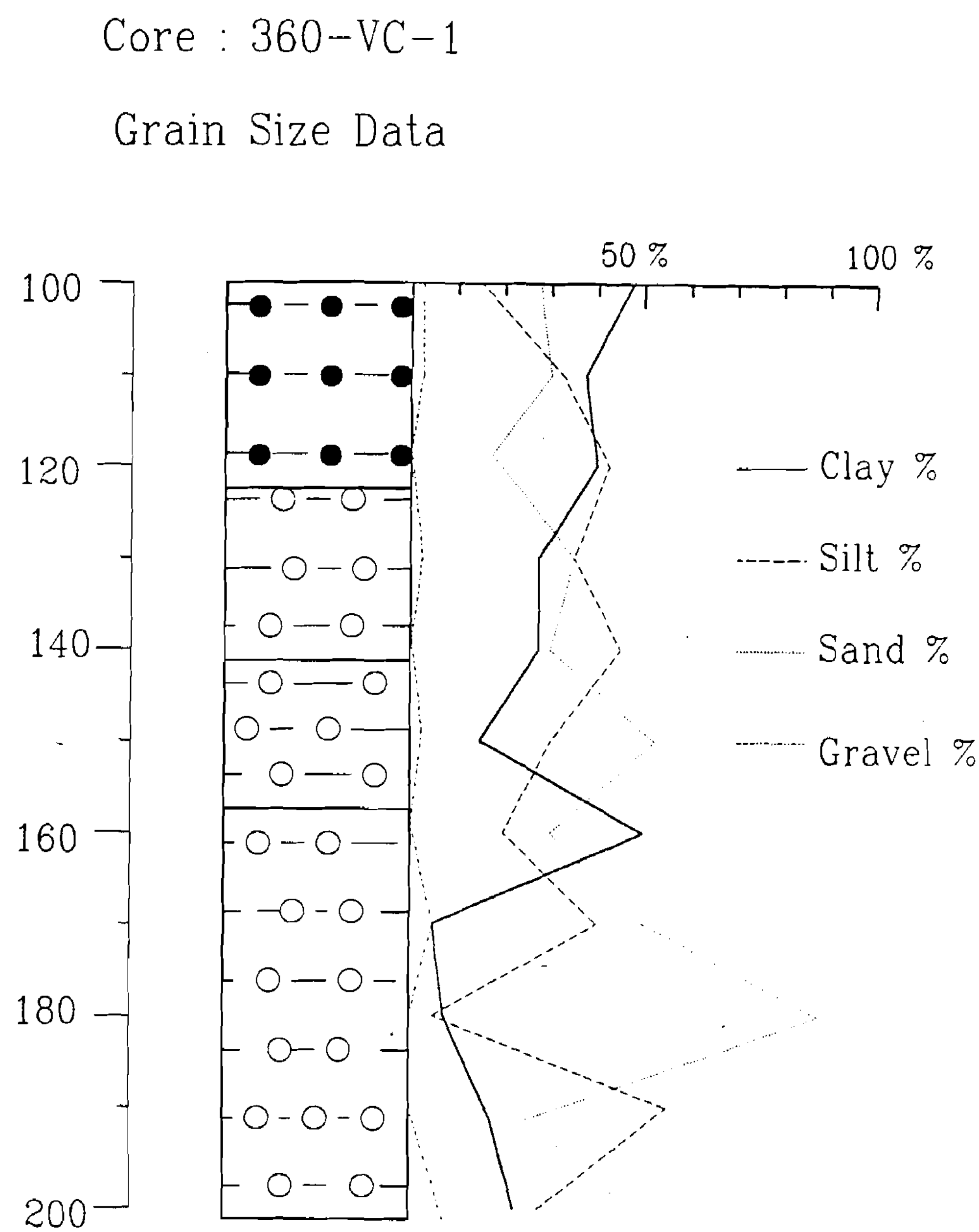


Figure 5. Percentages of clay, silt, sand, and gravel for core 360-VC-1 (logged as 360-VC-1B in Figure 6B and Appendix I).

CORE: 360-VC-1A

LOCATION:

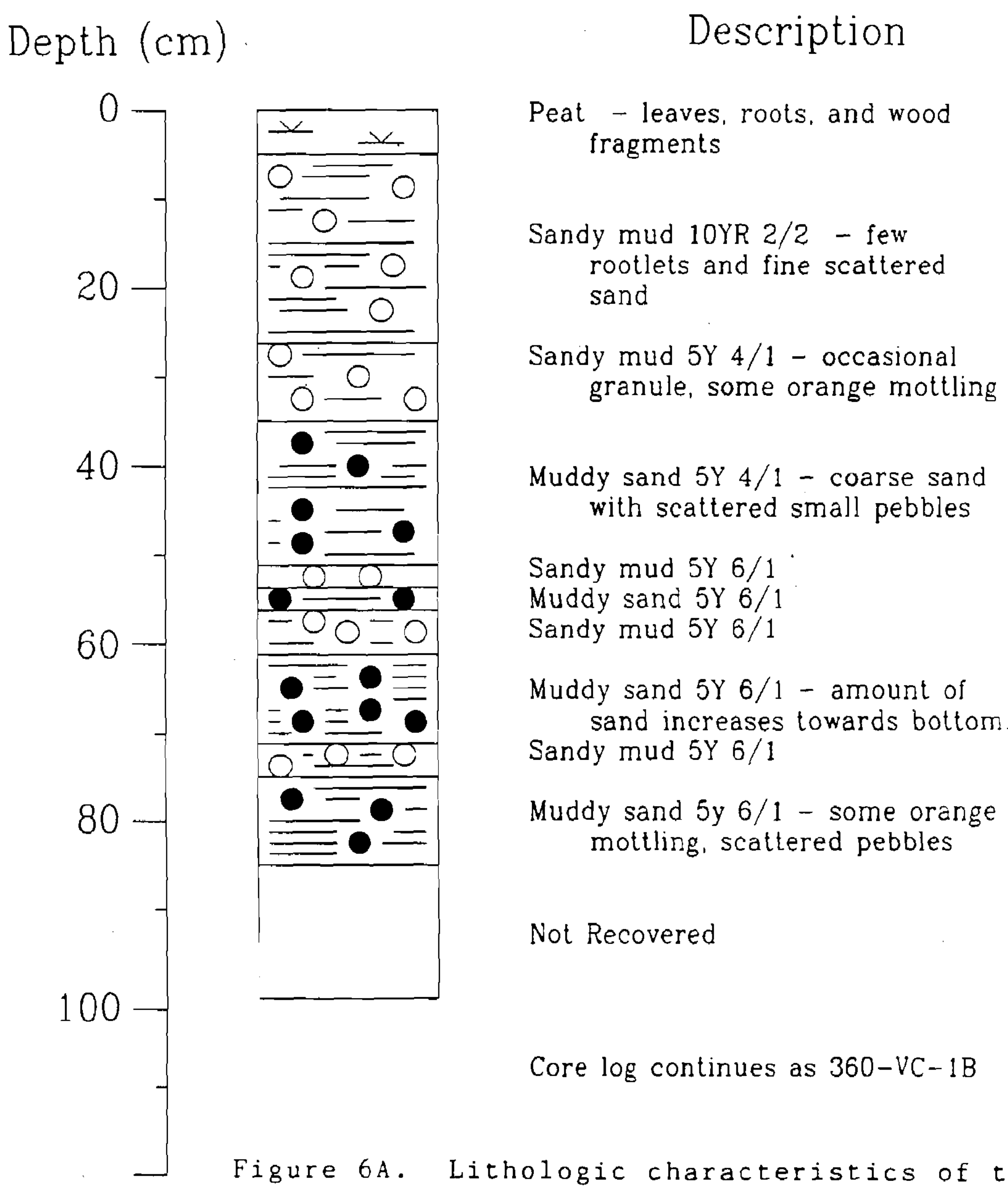
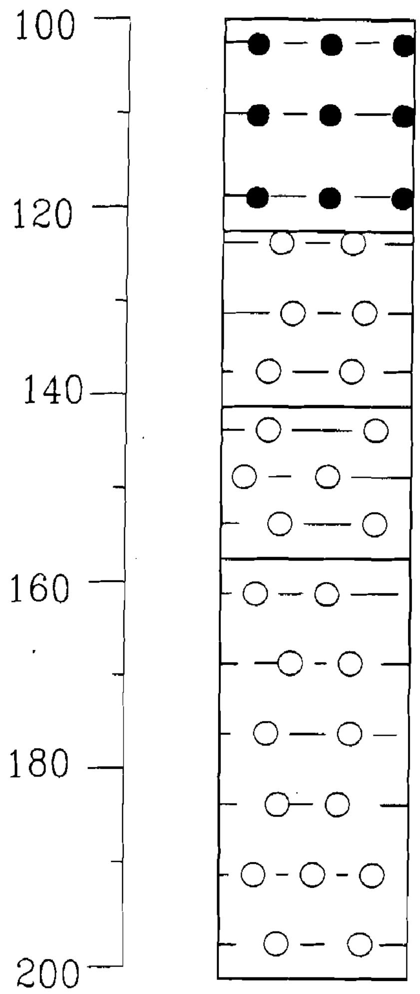


Figure 6A. Lithologic characteristics of the olive gray muddy sand facies (5-85 cm). The peat facies (0-5 cm) is also present in this core.

Core : 360-VC-1B

Depth (cm)



Description

Light olive gray (5Y 6/1) muddy sand Mostly medium-coarse sand with scattered pebbles.

Light olive gray sandy mud. Scattered grains of fine-medium sand. Intense orange mottling throughout unit.

Light gray (N7). Otherwise same as above.

Dark yellowish brown (10 YR 4/2) sandy mud w scattered grains of fine to medium sand, and occasional granules and pebbles. There are several layers (1-3 cm thick) composed of fine to medium sand seen throughout this unit.

Figure 6B. Lithologic characteristics of the olive gray muddy sand facies (100-122 cm). The olive gray sandy mud facies is also present in this core (122-200 cm).

Table 1. Summary of grain size analyses of the olive gray mud facies.

Depth (cm)	% Clay	% Silt	% Sand	% Gravel
100	46	26	27	1
110	37	32	30	1
120	41	41	18	0
130	28	36	35	1
140	27	44	29	0
150	17	30	52	1
160	50	21	29	0
170	5	40	50	5
180	6	6	88	0
190	18	56	26	0
200	23	27	45	5
ave. ± std. dev.	28±13[a]	33±13[a]	39±19[a]	1±2[a]

[a] - corresponds to 61±26% mud.

Table 2. Radiocarbon dates

Core	Depth (cm)	Laboratory Number	Age[a] (years B.P.)
360-VC-1A	16-22	Beta-41262	780 ± 70
360-VC-1B	144-154	Beta-41263	15,720 ± 520

[a] - uncorrected C^{14} Age ± 1 Sigma

moderate brown (10 YR 3/4), dusky yellowish brown (10 YR 2/2), and grayish brown (5 YR 3/2). The peat unit varies from 5 cm to about 52 cm in thickness. A radiocarbon date from the base of this unit yielded an age of 780 years B.P. (Table 2).

DISCUSSION

The lithological characteristics and stratigraphic position of the dark yellowish brown gravelly sand facies is typical of the pre-Holocene deposits of the area (Pickett and Benson, 1983). According to Pickett and Benson's geologic map, the dark yellowish brown gravelly sand facies should represent the Pleistocene (?) Columbia Formation. The prominent ridge and swale topography could represent ancient beach ridges or possibly dunes (though the relatively coarse sediments of this facies render aeolian transport and deposition rather unlikely).

The fine-grained nature of the olive gray sandy mud facies suggests deposition in a quiescent environment. The pollen analyses indicate deposition in a freshwater environment, a conclusion which is further indicated by the radiocarbon date of 15,780 years B.P., as sea level was many tens of meters below the elevation of this facies during this time (Belknap and Kraft 1977). The stratigraphic setting and lithologic characteristics of the olive gray sandy mud facies are consistent with deposition in a small lake. The sandy laminae would represent deposition during storms or other events which could enhance the local rate of sediment supply to the basin. These sandy laminae could represent enhanced supply by aeolian processes, similiar to that observed by Keen and Shane (1990) in a similiar setting in Minnesota. Or additional sand could have been supplied by slope processes or perhaps by small streams.

The olive gray muddy sand facies represents continued sedimentation after the lake filled in. These deposits represent a moist wetland environment, but one which was not as frequently inundated as the present wetland (which deposits sediments with a higher organic content). This age of this environment is unknown, as the olive gray muddy sand facies does not contain an abundance of datable material. However, because the lacustrine environment dates from the earliest Holocene, it is likely that the lake filled in early in the Holocene, perhaps has early as 10,000 years ago (though without additional geochronologic control this estimate is purely speculative).

The peat unit represents deposition in the modern palustrine forested wetland. According to the radiocarbon date of 780 years B.P., the modern wetland is relatively young. However, the sample used to obtain this date is very near the surface (it was obtained from a depth of only about 20 cm), and the possibility of contamination by modern roots or other modern organic matter should not be discounted.

CONCLUSION

During the Pleistocene (?), the ridge and swale topography of the Columbia Formation was deposited as a series of beach ridges or possibly dunes. During the earliest Holocene, a lake occupied the environs of the study area. The lake filled in early in the Holocene, and it was replaced by a moist forested wetland. During the last 1,000 years, the modern palustrine wetland developed.

ACKNOWLEDGEMENTS

Suku John and Kathi Stetser assisted in the field and the laboratory. Monica Tsang drafted some of the figures. The personnel of the University of Delaware Center for Archaeological Research provided assistance in the field, and also assistance in obtaining background information about the site.

REFERENCES

Belknap, D. F. and Kraft, J. C. 1977. Holocene relative sea-level charges and coastal stratigraphic units on the northwest flank of the Baltimore Canyon Trough Geosyncline. Journal of Sedimentary Petrology, 47:610-629.

Folk R. L. 1974. Petrology of Sedimentary Rocks. Hemphill, Austin, TX. 182p.

Folk, R. L., Andrews, P. B., and Lewis, D. W. 1970. Detrital sedimentary rock classification and nomenclature for use in New Zealand. New Zealand Journal of Geology and Geophysics, 13:937-968.

Hoyt, W. M., and Demarest, J. M. 1981. Vibracoring in Coastal Environments. University of Delaware Sea Grant College Publication DEL-SG-01-81. Newark, DE 34p.

Keen, K. L. and Shane, L. C. K. 1990. A continuous record of Holocene eolian activity and vegetation change at Lake Ann, east-central Minnesota. Geological Society of America Bulletin, 102:1646-1657.

Pickett, T. E., and Benson, R. N. 1983. Geology of the Dover Area. Delaware Geological Survey, Geologic Map Series #6.

Rock Color Chart Committee, 1991. Rock Color Chart, Geological Society of America, Boulder, CO.

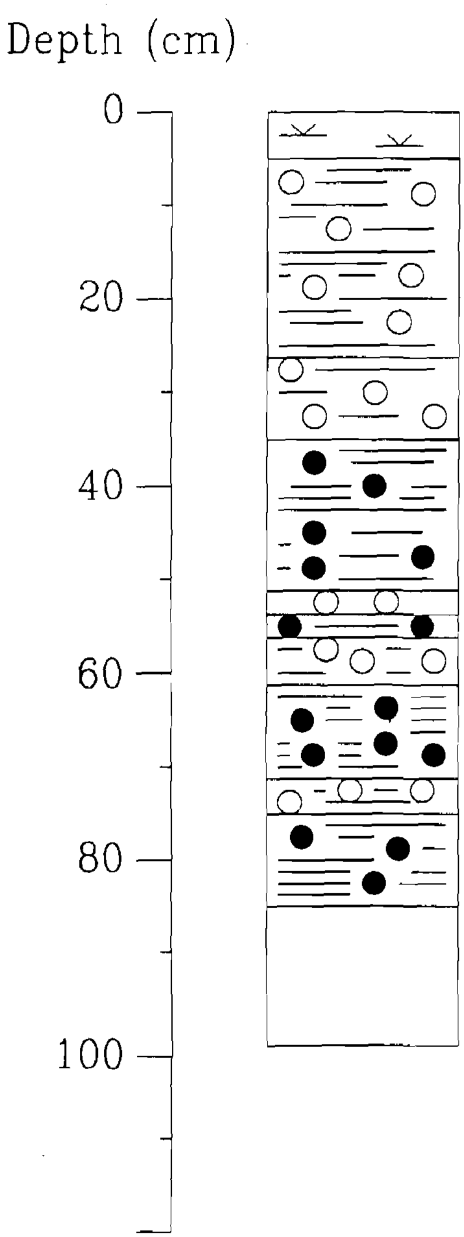
APPENDIX I

GRAPHIC CORE

LOGS

CORE: 360-VC-1A

LOCATION:



Description

Peat - leaves, roots, and wood fragments

Sandy mud 10YR 2/2 - few rootlets and fine scattered sand

Sandy mud 5Y 4/1 - occasional granule, some orange mottling

Muddy sand 5Y 4/1 - coarse sand with scattered small pebbles

Sandy mud 5Y 6/1
Muddy sand 5Y 6/1
Sandy mud 5Y 6/1

Muddy sand 5Y 6/1 - amount of sand increases towards bottom.
Sandy mud 5Y 6/1

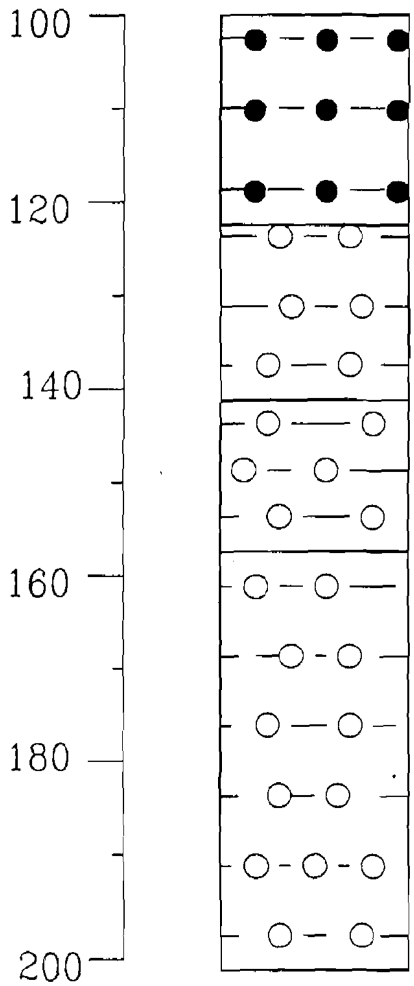
Muddy sand 5y 6/1 - some orange mottling, scattered pebbles

Not Recovered

Core log continues as 360-VC-1B

Core : 360-VC-1B

Depth (cm) | Description



Light olive gray (5Y 6/1) muddy sand Mostly medium-coarse sand with scattered pebbles.

Light olive gray sandy mud. Scattered grains of fine-medium sand. Intense orange mottling throughout unit.

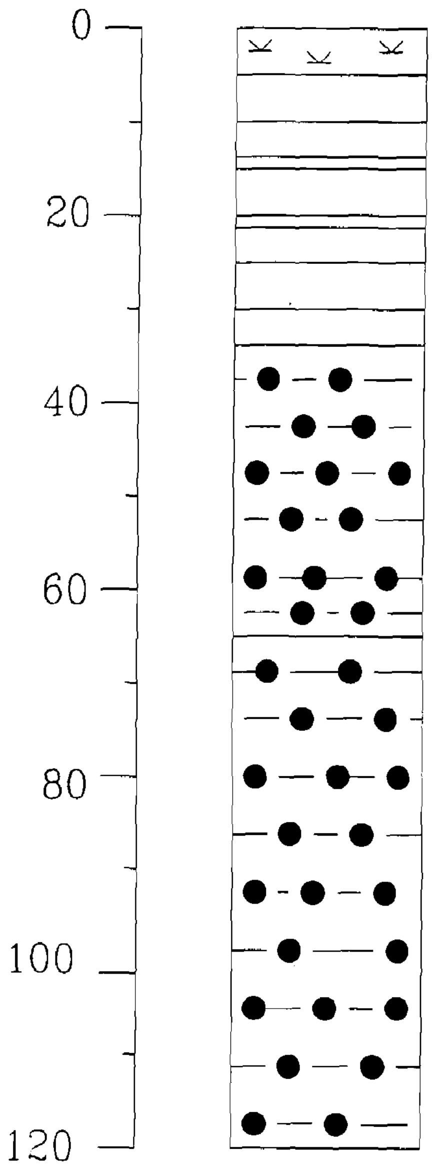
Light gray (N7). Otherwise same as above.

Dark yellowish brown (10 YR 4/2) sandy mud w scattered grains of fine to medium sand, and occasional granules and pebbles. There are several layers (1-3 cm thick) composed of fine to medium sand seen throughout this unit.

CORE: 360-VC-2AB

LOCATION:

Depth (cm)



Description

Peat with small amount of mud

Mud 5YR 2/2 - occasional scattered fine sand and many rootlets

Mud 10YR 2/2 - occasional scattered sand, less rootlets

Similar to above unit but more compacted and orange mottling at bottom

Muddy sand 5Y 4/1

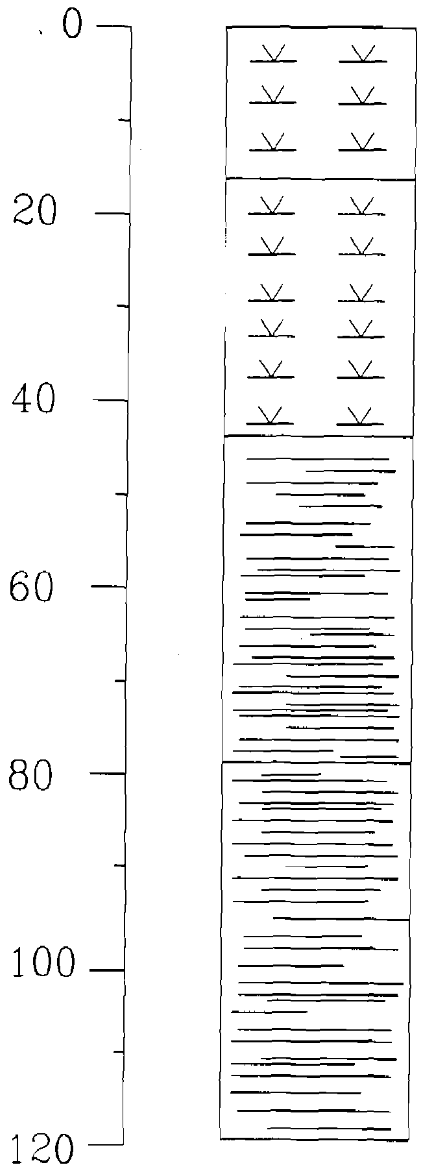
Muddy sand 5Y 6/1 - fine scattered sand, intense orange mottling. More compact than above unit. Isolated small patches with more sand.

Unit continues to 130 cm.

CORE: 360-DC-2A

LOCATION: 7-K-C-360

Depth (cm) | Description



Peat - 10YR 4/2 to 5YR 3/2

Muddy peat - 5YR 2/1

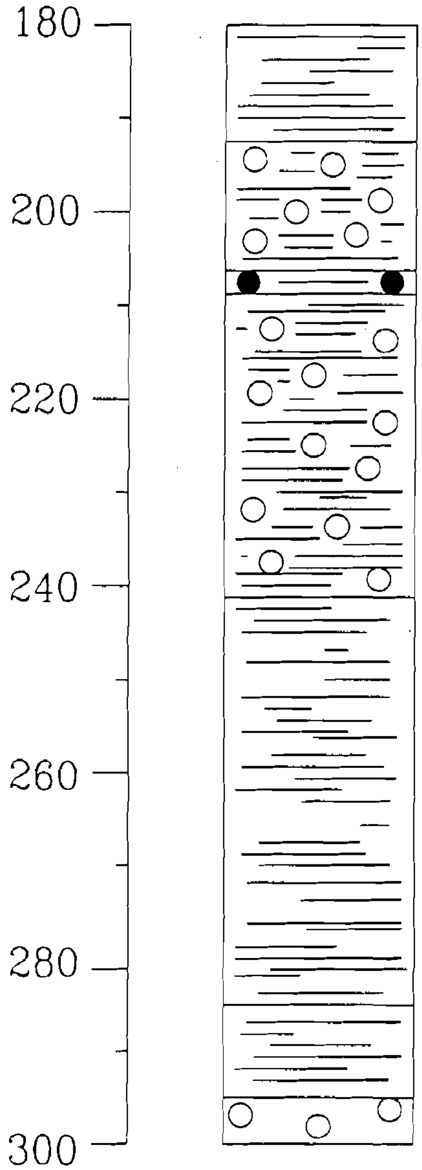
Mud - 5YR 2/1 with occasional fibres, rootlets and small gray mottles

Mud - N7 with few small rust colored mottles, rare sand grains and granules.
Unit continues to 192 cm

CORE: 360-DC-2B

LOCATION: 7-K-C-360

Depth (cm)



Description

Mud - continues from 79 cm

Sandy mud - N7 with abundant rust colored mottles

Muddy sand

Sandy mud - N7 with abundant rust colored mottles which decrease toward bottom

Mud - 5Y 4/1

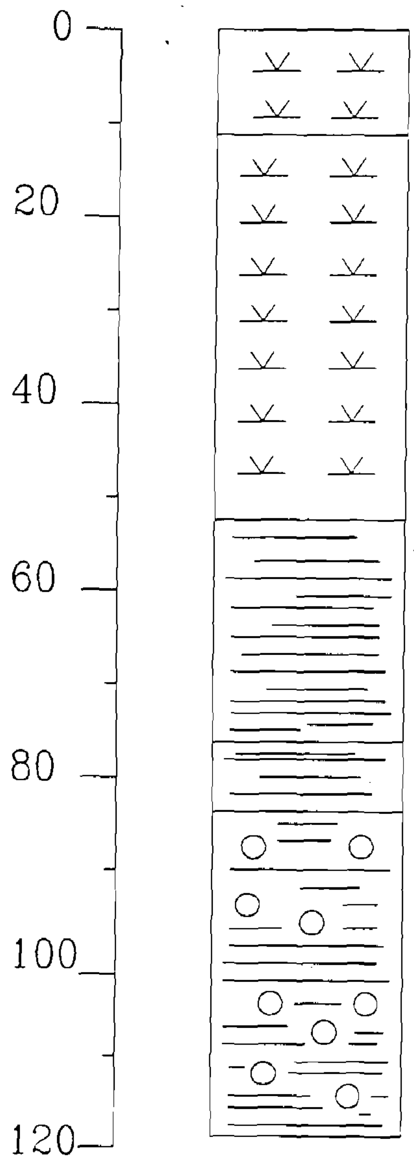
Laminated mud - slightly lighter than above unit

Sand - N3 with black mottles

CORE: 360-DC-3A

LOCATION: 7-K-C-360

Depth (cm) | Description



Peat - 10YR 4/2 to 5YR 3/2

Muddy peat - 5YR 2/1

Mud - 5YR 2/1 with occasional fibres and rootlets. Small light gray mottles

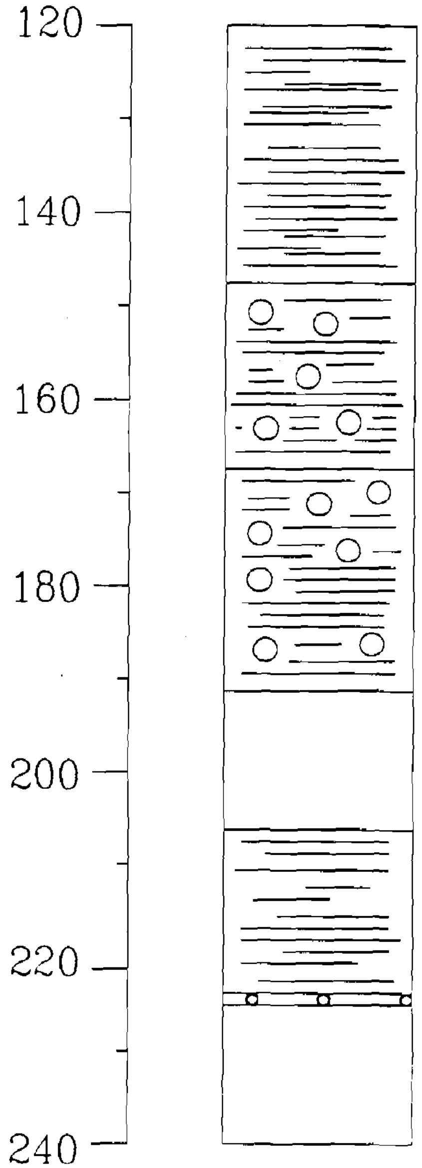
Mud - N7

Sandy mud - N7 grading at bottom to muddy sand with granules, poorly sorted medium to coarse sand, abundant mud and gravel.

CORE: 360-DC-3B

LOCATION: 7-K-C-360

Depth (cm) | Description



Mud - N7 with few rust colored mottles and increasing sand content downward

Sandy mud - N7 with abundant rust colored mottles

Sandy mud with occasional rust colored mottles and increased sand content downward

No recovery

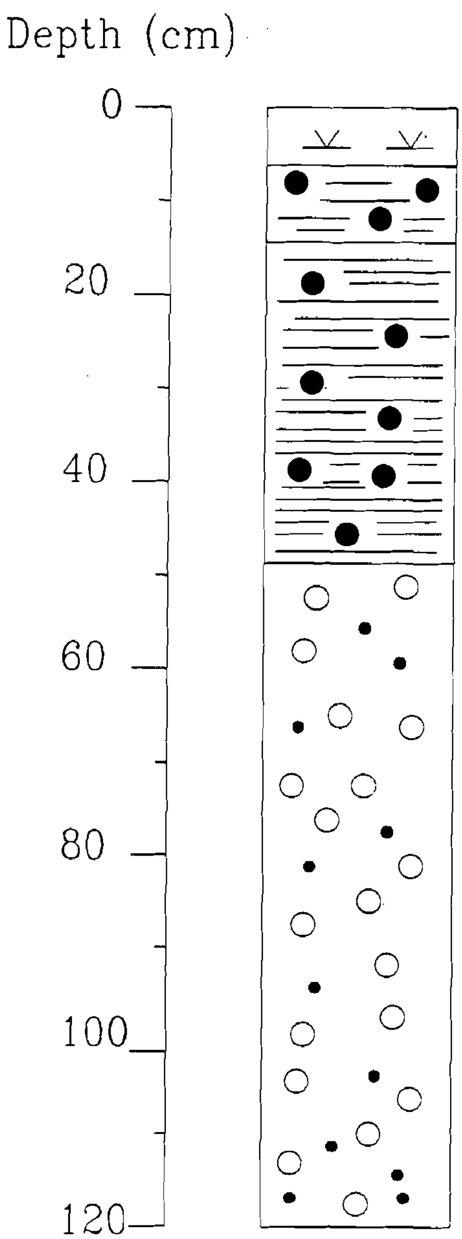
Mud - 5YR 5/2 with laminations. (One quartz granule in middle) Sharp contact at bottom.

Fine sand

No recovery - (sand ?)

CORE: 360-DC-4A

LOCATION: 7-K-C-360



Description

0 horizon

Muddy sand (fine). Brownish black (5 YR 2/1)

Muddy sand (fine-medium), light gray (N7) with rust-colored mottles

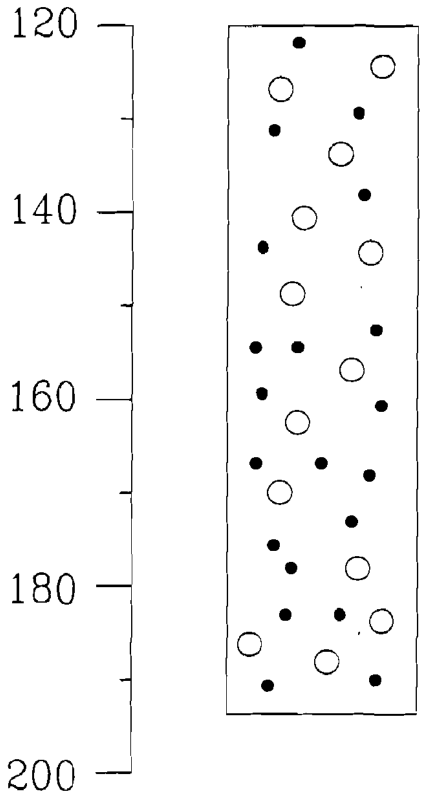
Light olive gray (5 Y 6/1) coarse sand. Slightly muddy matrix.

Continues as 360-DC-4B

CORE: 360-DC-4B

LOCATION: 7-K-C-360

Depth (cm) Description

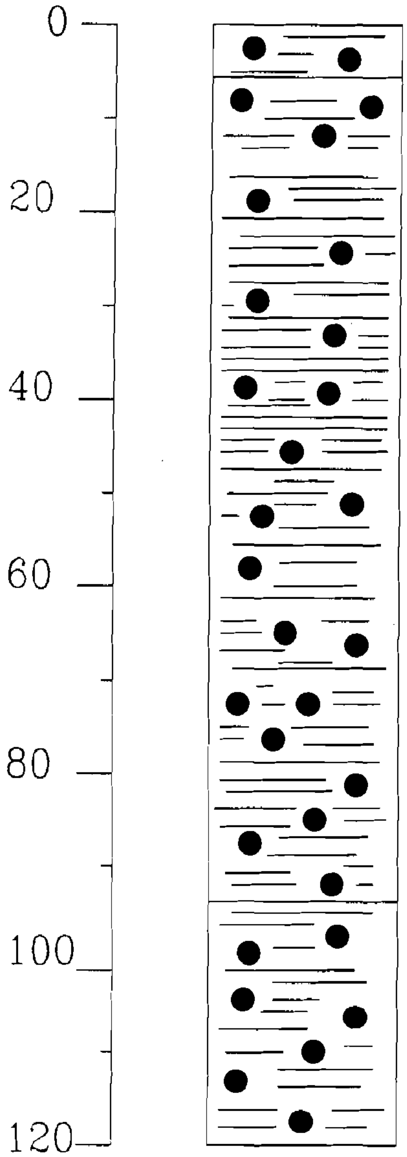


Gravelly sand. Gravel grains are granules.
Dark yellowish brown (10 YR 4/2).

CORE: 360-DC-5A

LOCATION: 7-K-C-360

Depth (cm) — Description



Muddy sand (coarse) with scattered granules. Grayish brown 5 YR 3/2

Muddy sand (coarse) with scattered granules. Light olive gray 5 Y 6/1. Abundant "large" orange mottles below 63 cm.

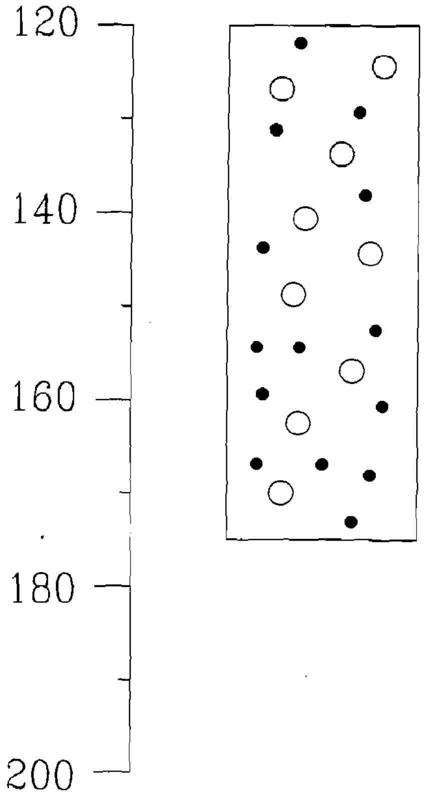
Muddy sand (coarse). Dark yellowish orange (10 YR 6/6).

Continues as 360-DC-5B

CORE: 360-DC-5B

LOCATION: 7-K-C-360

Depth (cm) | Description



Gravelly sand. Gravel grains are granules, and pebbles.
Dark yellowish orange (10 YR 6/6).

APPENDIX II

POLLEN ANALYSES

UNIVERSITY OF DELAWARE INTER-DEPARTMENTAL

Memorandum

January 8, 1991

TO: James E. Pizzuto
Geology Dept.
Penny Hall

FROM: Johan J. Groot
Delaware Geological Survey

RE: Palynology, core 360 (east of Cheswold)

Two samples of this core were processed. Both had abundant palynomorphs.

Sample 360-86.

Arboreal pollen: mostly pine and spruce; non-arboreal; sedges, grasses, composites, fresh water plants, mosses. NAP 43%.
Interpretation: fresh-water marsh surrounded by a pine-spruce forest. Cold climate.

Sample 360-167.

Arboreal pollen: pine and spruce; non-arboreal: sedges, grasses, mosses. NAP 24%.
Interpretation: as 360-86.

Your ^{14}C date is not surprising. 15,000 years ago it was pretty cold here!

Any comments?

dcw

cc: R. R. Jordan

APPENDIX IV

PALEOGEOMORPHIC HISTORY OF DOVER DOWNS "HILL A" (ARCHAEOLOGICAL SITE 7K-C-365A)

PALEOGEOMORPHIC HISTORY OF DOVER DOWNS "HILL A"

(ARCHAEOLOGICAL SITE 7K-C-365A)

James E. Pizzuto
Department of Geology
Newark, DE 19716

June 1992

INTRODUCTION

The goal of this report is to describe the Holocene geomorphic history of Dover Downs "Hill A" (Archaeological Site 7K-C-365A).

LOCATION

The site is located in Kent County, Delaware, just north of the Dover Downs racetrack (Figure 1). The excavations are located in the crest of a small hill in the right-of-way of the Rt. 13 Relief Route (Figure 2). A small stream, Muddy Branch, is located to the north of the site (Figure 2). It originates in a wetland (a palustrine forested swamp) northeast of the site and flows eastward towards Delaware Bay.

METHODS

A reconnaissance survey of the site suggested that geomorphic data were likely to be preserved in the floodplain and swamp associated with Muddy Branch. Thus, cores were collected from this area.

The sediments of the swamp, and environs were sampled by taking six cores (Figure 2). Two of these cores were obtained using 3" aluminum pipe and vibradrilling equipment using methods described by Hoyt and Demarest (1981). The other four cores were obtained using a 2.5 cm Eijelkamp hand-driven auger and a 3" bucket auger. The Eijelkamp corer was typically suitable for sampling the organic-rich upper horizons at the site, while the bucket auger was better suited for sampling the lower horizons. All coring sites were located using a hand level, tape, and Brunton compass.

Hand-driven cores were described in the field. Vibracores were returned to the lab, split, described, and sampled for subsequent analyses.

Selected samples from the cores were analyzed for loss-on-ignition (LOI) and % sand, silt, and clay. LOI analyses provide an estimate of the content of organic carbon contained in a sample; these analyses were performed following methods described by (Ball, 1964). Methods of Folk (1974) were used to determine the percentages of sand, silt, and clay. The classification of Folk et al. (1970) was used in describing different lithologies.

Grain size analyzes were not performed in samples actually obtained at the Dover Downs site. However, similar sediments were sampled from Site 7-KC-360 located approximately 4 km northwest of the Dover Downs site (Pizzuto 1992). Grain size data from these sediments are used to provide an indirect estimate of the grain size of correlative sediments at the Dover Downs site.

RESULTS

Four lithofacies were encountered in the cores (Figure 3 and Appendix I). The lowest unit is a mottled orange and brown sand and gravel which is massive to weakly bedded (106 to 112 cm in JEP-DD-1, Figure 3, Appendix I). The next higher unit is composed of olive gray and light olive gray massive mud, (82 cm to 106 cm in JEP-DD-1, Figure 3). The next higher unit is composed of black and brown mud, sandy mud and muddy sand with scattered gravel (primarily pebbles and granules). The uppermost unit in all of the cores (except DD-DC-5 and DD-DC-6) consists of black peat and organic-rich mud.

As noted above, grain size analyses were not directly performed on samples from the Dover Downs site. However, the olive gray and light olive gray mud sampled at the Dover Downs site is unusual and it is also quite similar to a muddy unit sampled at Site 7-C-360. Grain size analyses from this similar unit are illustrated in Figure 4. The core contains about 1 meter of sandy mud. These sediments contain on the average, 28% clay, 33% silt, 39% sand, and 1% gravel. This is equivalent to 61% mud (Table 1).

Loss-on-ignition analyses for cores JEP-DD-1 and JEP-DD-2 are presented in Figures 5 and 6. All LOI values are less than 30%, and the values decrease consistently with increasing depth. Of the 4 units defined in core JEP-DD-1, average LOI values are 0.2 ± 0.2 (orange and brown sand and gravel), 2.2 ± 0.7 (olive gray mud), 4.7 ± 3.0 (black and brown sandy mud and muddy sand), and 14.5 ± 6.7 (organic-rich mud). LOI analyses are also summarized in Table 2.

DISCUSSION

The highly weathered and dense nature of the orange and brown sand and gravel facies is typical of the Miocene Calvert Formation and Pleistocene(?) Columbia Formation in the area (Pickett and Benson, 1983). These deposits are eroded into a distinctive hill-and-swale topography in the vicinity of the site. The processes which formed this characteristic topography are unknown, although the hills could represent beach ridges or dunes.

The overlying olive-gray mud facies was probably deposited in a lacustrine environment (Figure 7). A quiet depositional setting is suggested by its relatively fine grain size. A lake is suggested as a likely environment based on pollen and radiocarbon analysis of similar sediments located in the vicinity of Site 7-K-360 (Pizzuto, 1992). The pollen recovered from these sediments indicate abundant pine, spruce, and freshwater wetland plant species in the area (Pizzuto, 1992) and a radiocarbon analysis yielded an age of $15,780 \pm 520$ years B.P. These data are consistent with the interpretation of these sediments as representing an early Holocene or late Pleistocene lacustrine environment.

After the demise of the lacustrine environment, a floodplain developed, followed by the present freshwater palustrine wetland. The floodplain

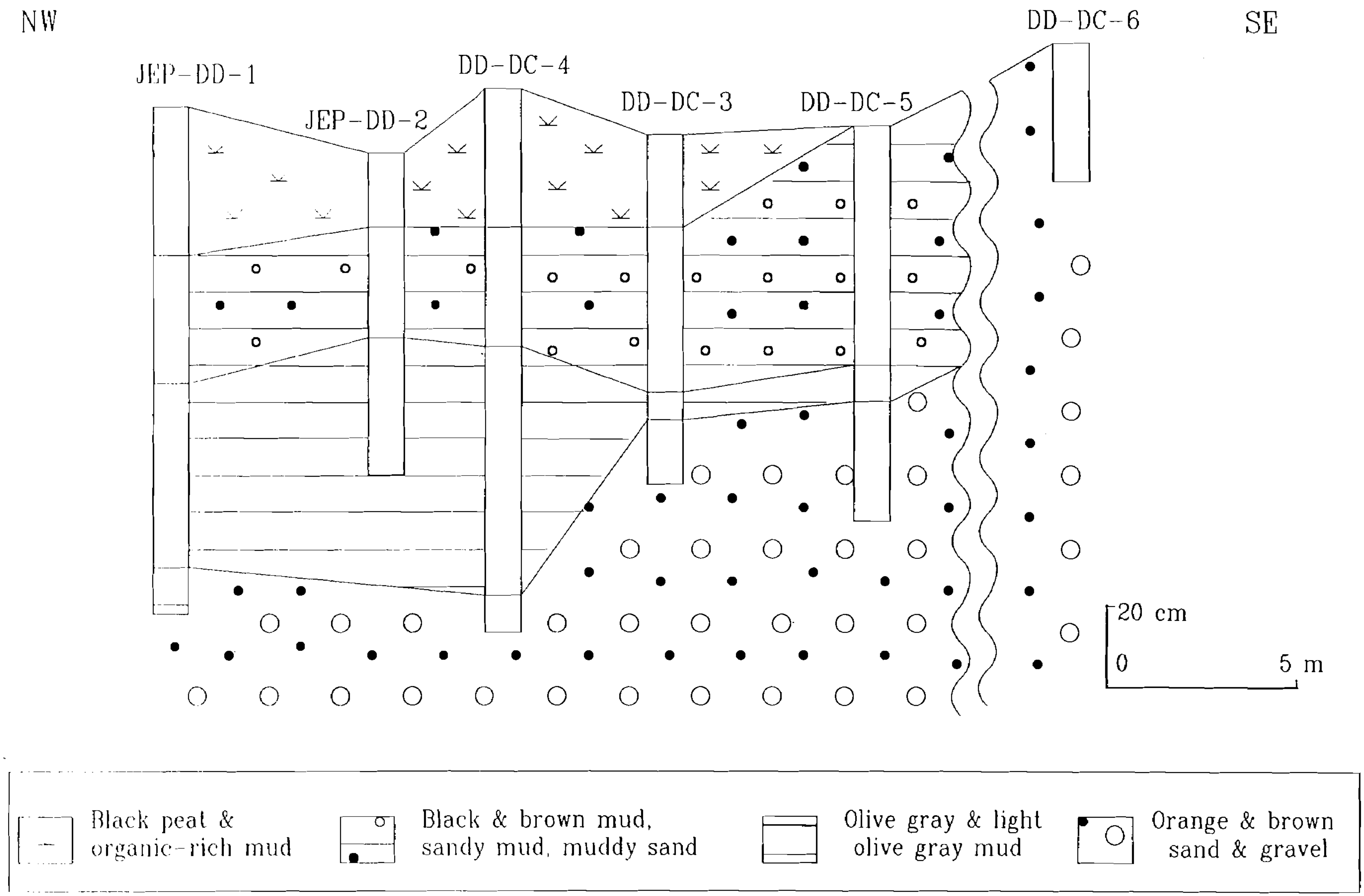


Figure 3. Geologic cross-section of the study area.

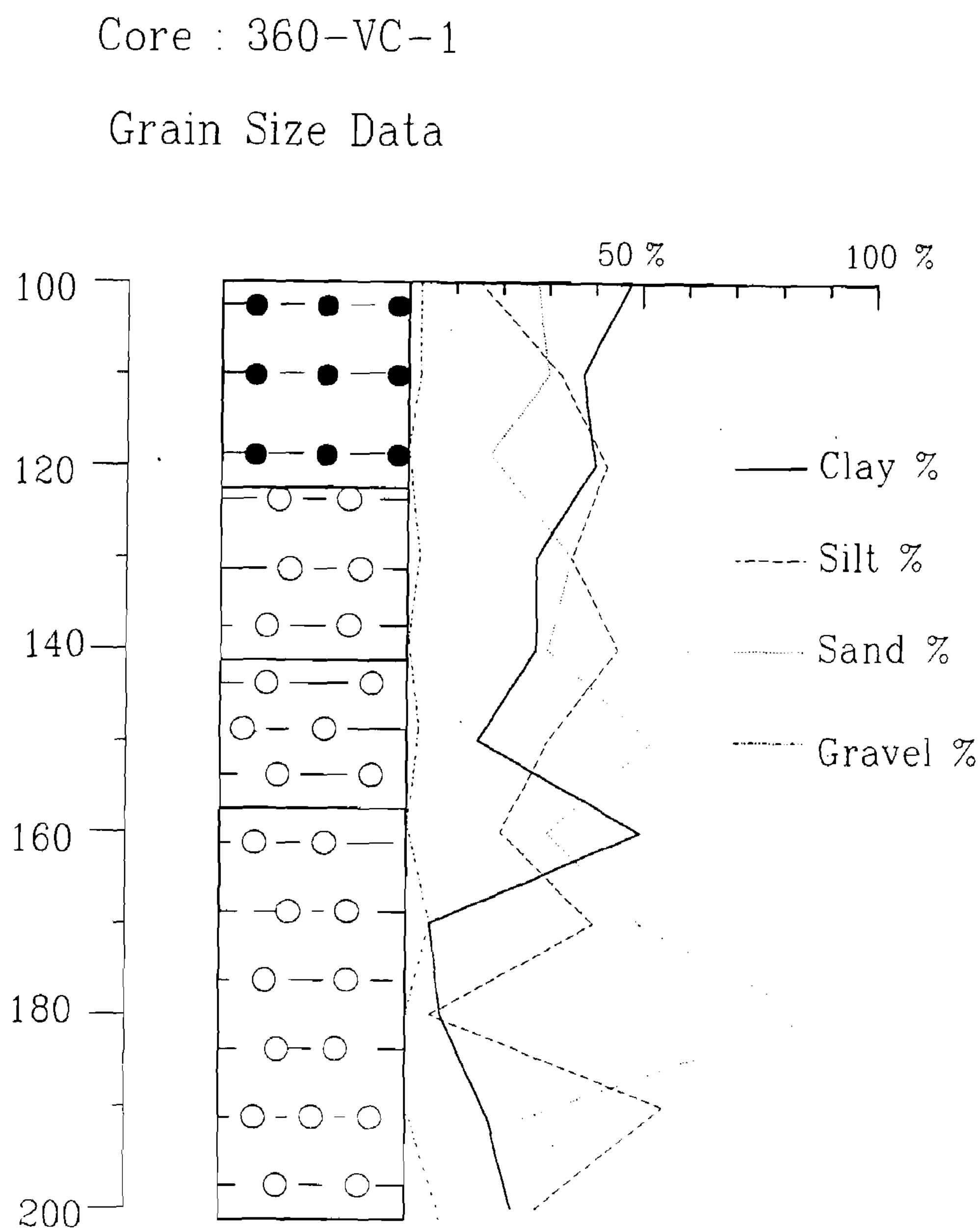


Figure 4. Percentages of clay, silt, sand, and gravel from Core 360-VC-1, obtained at Archaeological Site 7K-C-360, approximately 4 km north-northwest of the study area. These sediments are similar to the olive gray and light olive gray mud facies.

Table 1. Summary of grain size analyses of the olive gray mud facies from Core 360-VC-1B (obtained from Site 7K-C-360, not from the Dover Downs Site).

Depth (cm)	% Clay	% Silt	% Sand	% Gravel
100	46	26	27	1
110	37	32	30	1
120	41	41	18	0
130	28	36	35	1
140	27	44	29	0
150	17	30	52	1
160	50	21	29	0
170	5	40	50	5
180	6	6	88	0
190	18	56	26	0
200	23	27	45	5
ave. ± std. dev.	28±13[a]	33±13[a]	39±19[a]	1±2[a]

[a] - corresponds to 61±26% mud.

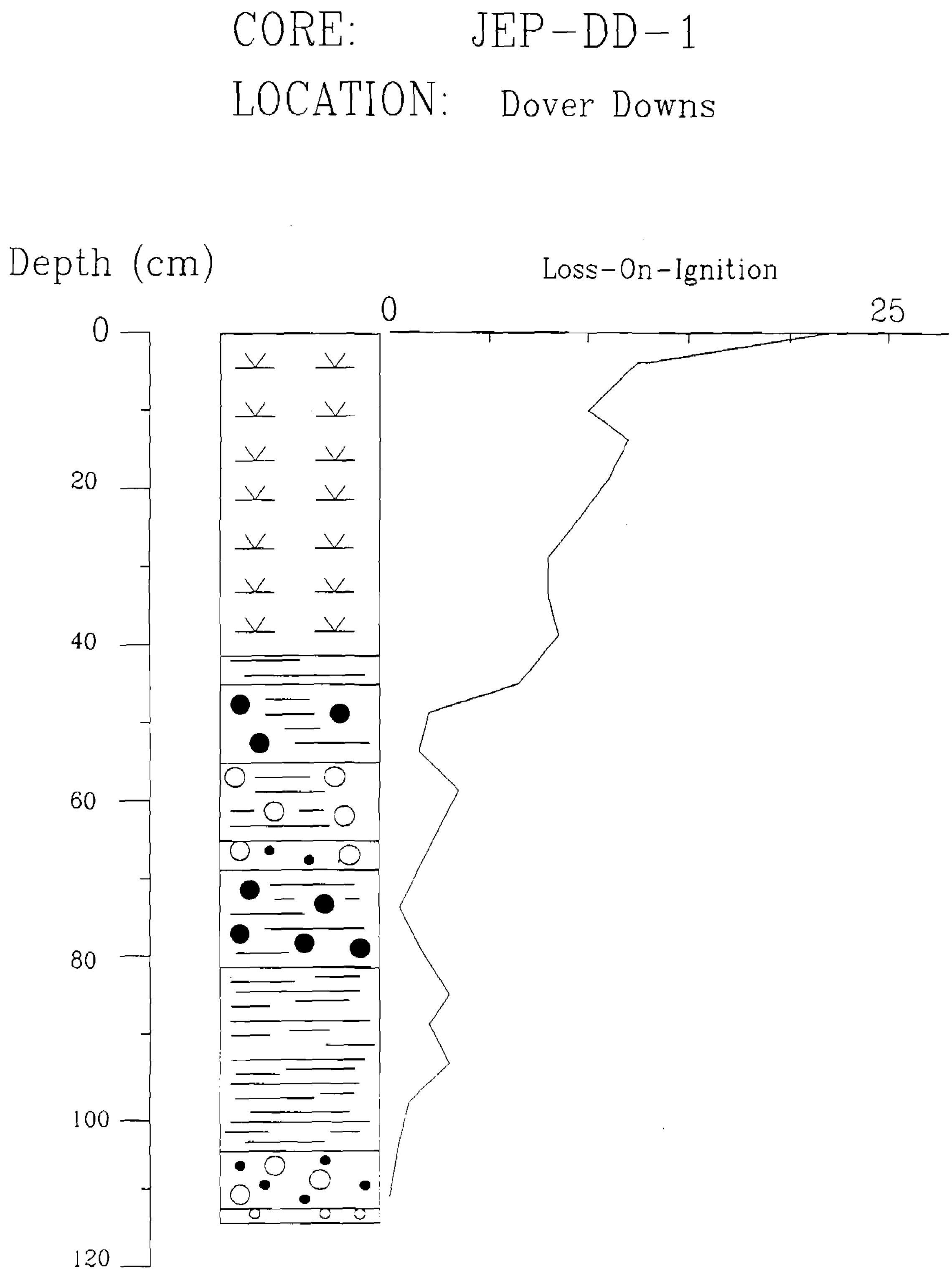


Figure 5. Loss-on-ignition analyses (presented in %) of samples from Core JEP-DD-1. A detailed core description is presented in Appendix I.

CORE: JEP-DD-2

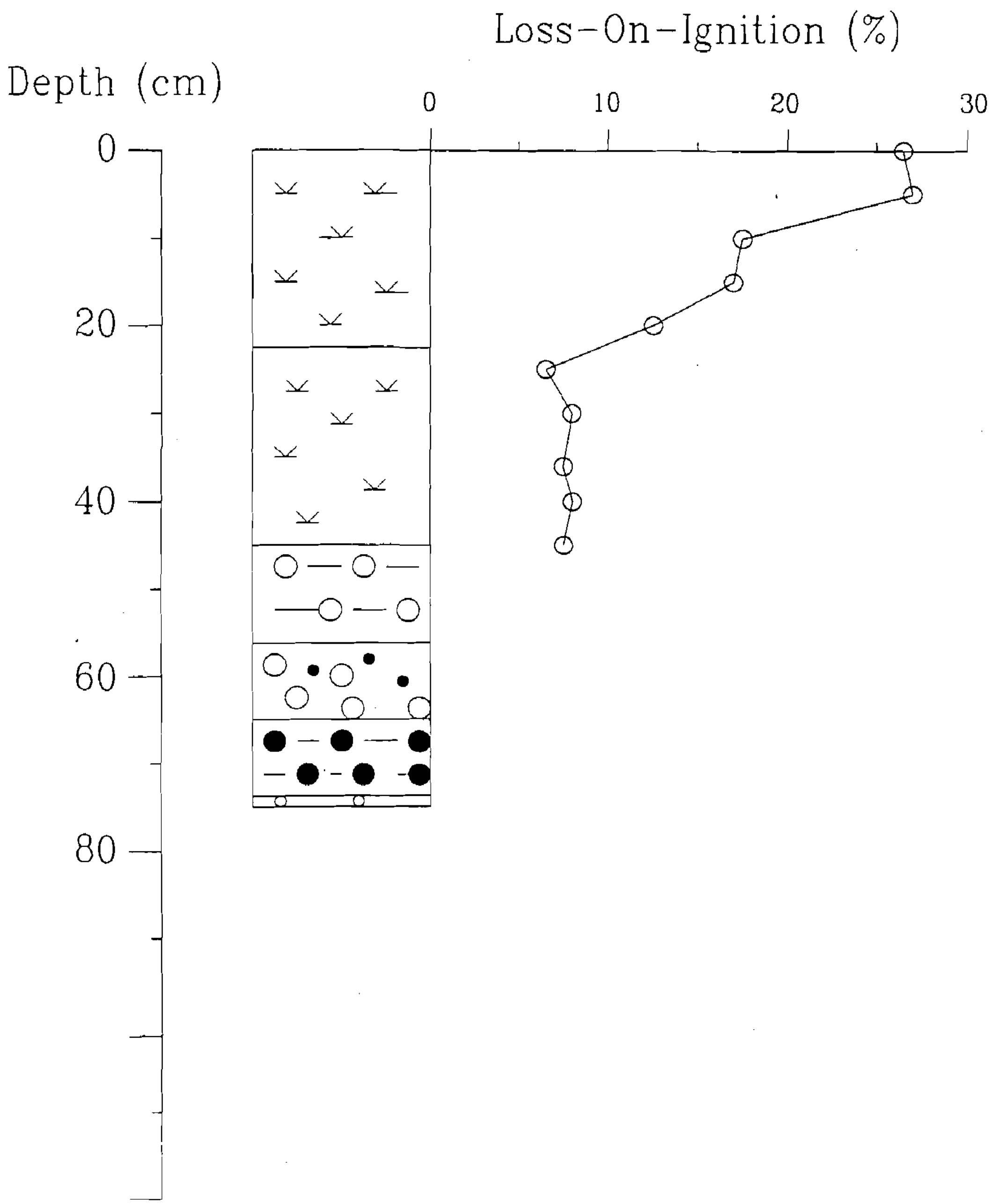


Figure 6. Loss-on-ignition analyses (presented in %) of samples from Core JEP-DD-2. A detailed description of this core is presented in Appendix I.

Table 2. Summary of Loss-On-Ignition Data for Cores JEP-DD-1, JEP-DD-2, and DD-DC-4

Core	Depth (cm)	LOI (%)	Facies	Core	Depth (cm)	LOI (%)	Facies
JEP-DD-1	0	21.9	om[a]	JEP-DD-2	0	26.9	om
	5	12.7	om		5	27.3	om
	10	10.8	om		10	17.2	om
	15	11.7	om		15	16.9	om
	20	11.3	om		20	12.6	om
	25	9.3	om		25	6.9	bsm
	30	7.7	om		30	8.1	bsm
	35	7.7	om		35	7.6	bsm
	40	8.5	om		40	8.0	bsm
	45	6.9	bsm[b]		45	7.5	bsm
	50	2.2	bsm	DD-DL-4	95	2.5	ogm
	55	1.4	bsm		110	2.6	ogm
	60	3.2	bsm		118	2.5	ogm
	65	2.5	bsm				
	70	1.6	bsm				
	75	0.8	bsm				
	80	1.2	bsm				
	85	3.1	ogm[c]				
	90	1.9	ogm				
	95	2.9	ogm				
	100	1.2	ogm				
	105	0.3	osg[d]				
	110	0.0	osg				

[a] - om = black organic-rich mud
[b] - bsm = black sandy mud
[c] - ogm = olive gray mud
[d] - osg = orange sandy gravel

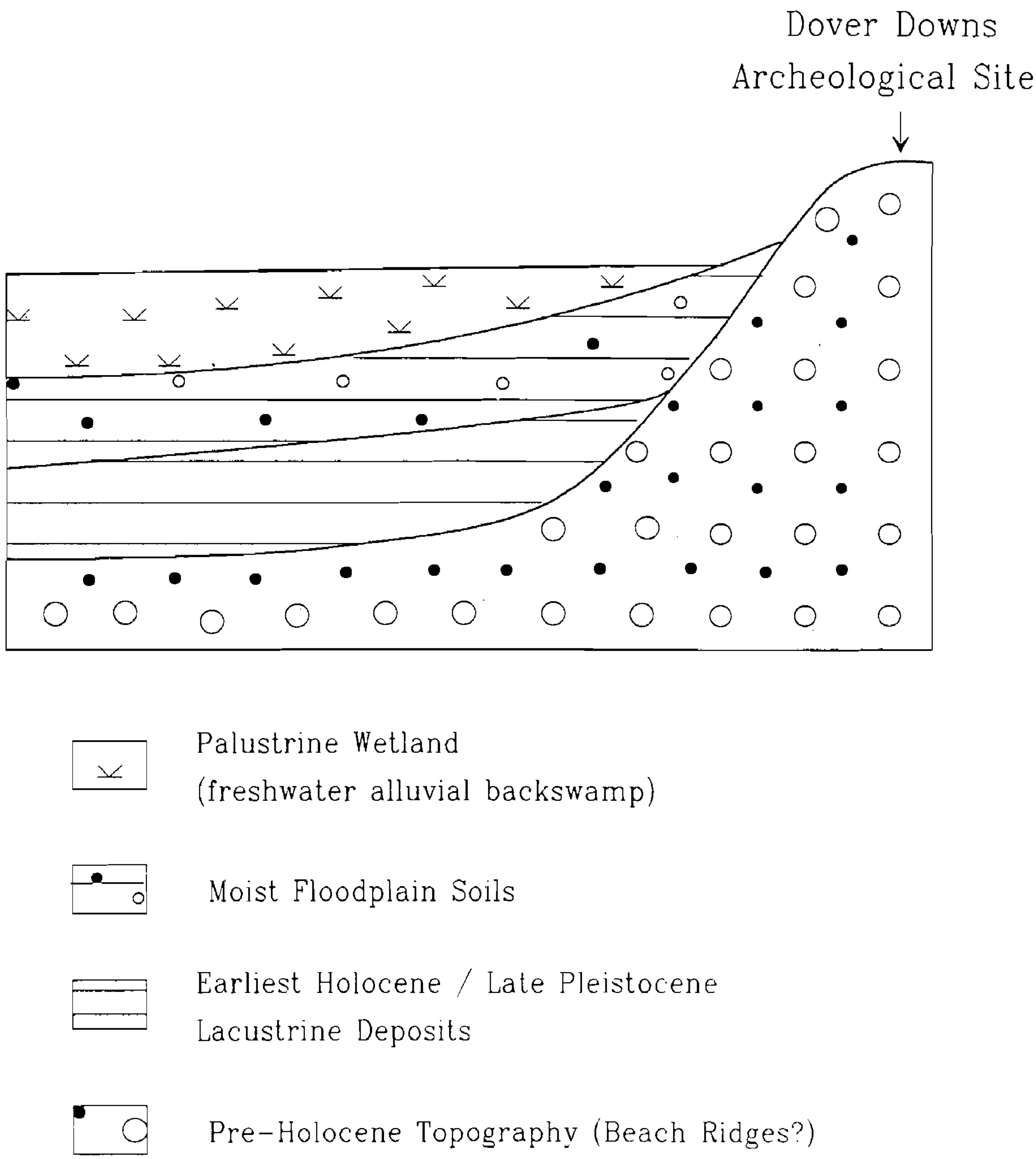


Figure 7. Generalized interpretive geologic cross-section of the study area.

environment contains little datable material, and therefore its chronology is difficult to establish. The base of a correlative wetland deposit at Site 7K-C-360 has been dated at 780 $\pm$ 70 years B.P., so the wetland which currently occupies the low areas surrounding the site probably developed quite recently.

CONCLUSION

Three Holocene environments have been identified in the vicinity of Site 7K-C-365A. A small lake occupied low areas during the early Holocene; this lake existed at least 16,000 years ago. Later, a floodplain developed. The date of this environmental change has not been established, but analyses of similar sites elsewhere (Pizzuto, 1992) suggest that the floodplain environment was established relatively early in the Holocene. About 1,000 years ago, the present freshwater palustrine wetland was established.

REFERENCES

Ball, D. F. 1964. Loss-on-ignition as an estimate of organic matter and organic carbon in non-calcareous soils. Journal of Soil Science, 15:84-92.

Folk R. L. 1974. Petrology of Sedimentary Rocks. Hemphill, Austin, TX. 182p.

Folk, R. L., Andrews, P. B., and Lewis, D. W. 1970. Detrital sedimentary rock classification and nomenclature for use in New Zealand. New Zealand Journal of Geology and Geophysics, 13:937-968.

Hoyt, W. M., and Demarest, J. M. 1981. Vibracoring in Coastal Environments. University of Delaware Sea Grant College Publication DEL-SG-01-81. Newark, DE 34p.

Pickett, T. E., and Benson, R. N. 1983. Geology of the Dover Area. Delaware Geological Survey, Geologic Map Series #6.

Pizzuto, J. E. 1992. Paleogeomorphic History of Archaeological Site 7-KC-360. Unpublished technical report, University of Delaware Center for Archaeological Research (in prep.).

APPENDIX I

GRAPHIC CORE

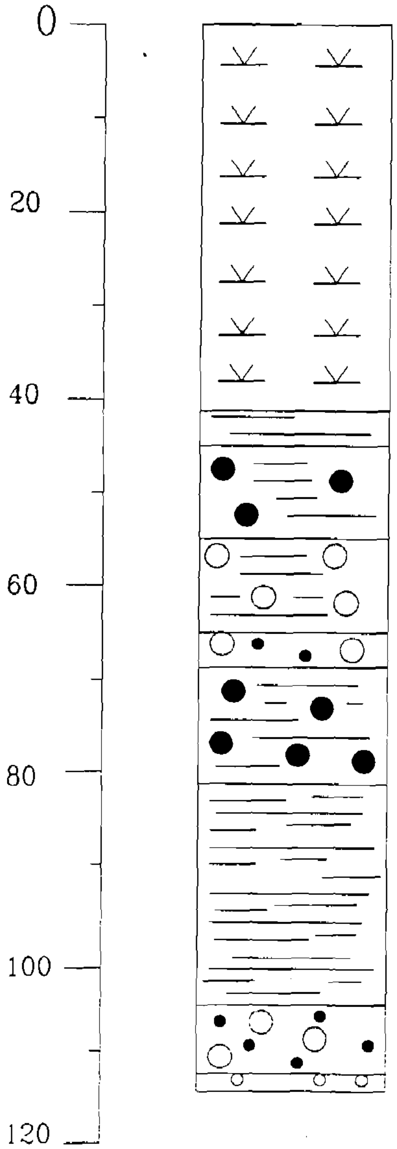
LOGS

CORE: JEP-DD-1

LOCATION: Dover Downs

Depth (cm)

Description



Peat. 5YR 2/1, abundant roots and plant fibres. Rare sand grains.

Mud 5YR 2/1 with scattered sand

Muddy sand 10YR4/2 to 10yr 2/2 with black mottles

Sandy mud 10YR 4/2 to 10YR 2/2 with orange mottles

Gravelly sand 5Y 4/1

Muddy fine sand 5Y 4/1 with small black mottles and more sand towards bottom

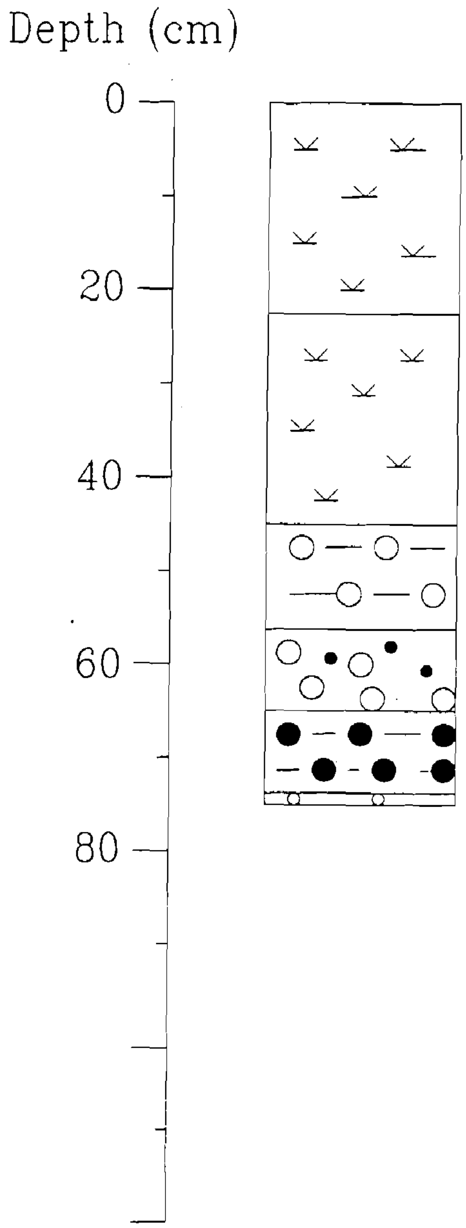
Mud 5Y 4/1 with minor amounts of sand and a pocket of organic rich muddy sand. Abrupt contact at base.

Gravelly sand 10YR 7/4. Weakly bedded. Almost no mud

Sand 10YR 6/6, with muddy matrix

CORE: JEP-DD-2

LOCATION: Dover Downs



Description

Peat 5YR 2/1 with abundant plant remains

Peat 5YR 2/1 . Compact, less plant remains and frequent scattered sand grains

Sandy mud 5Y4/1. Grades to muddy sand at base with pebbles. Many small root fibres.

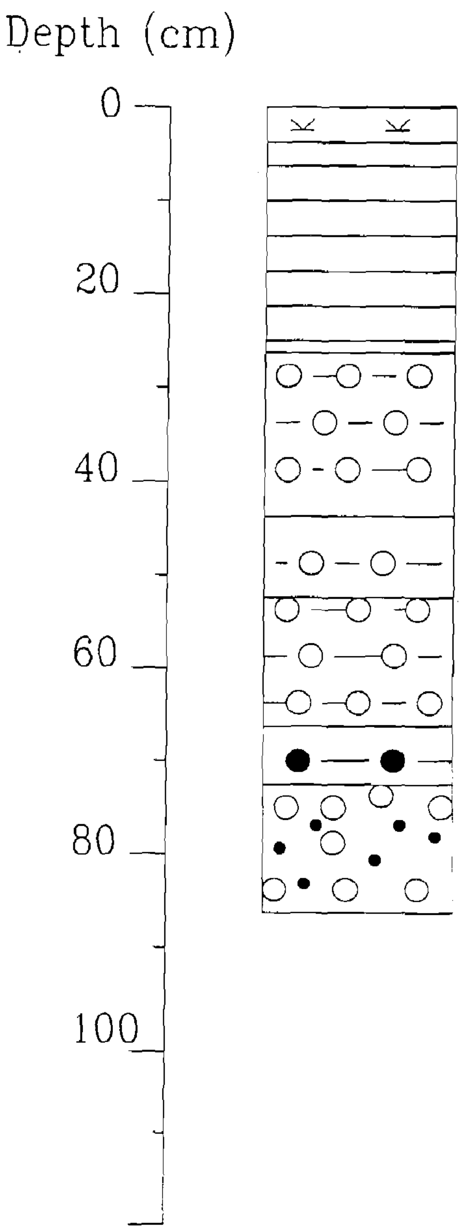
Gravelly sand 10YR 2/2

Muddy sand 5Y 6/1 with 30% gravel

Silty fine grained sand 5Y 4/1

CORE: DD-DC-3

LOCATION: Dover Downs



Description

Black muddy peat

Black mud with abundant coarse sand, plant fibres and rare granules.

Dense sandy mud - dusky yellowish brown, with some granules and abundant root fibres.

Sandy mud - brown with black mottles, occasional granule and pebble, abundant rootlets.

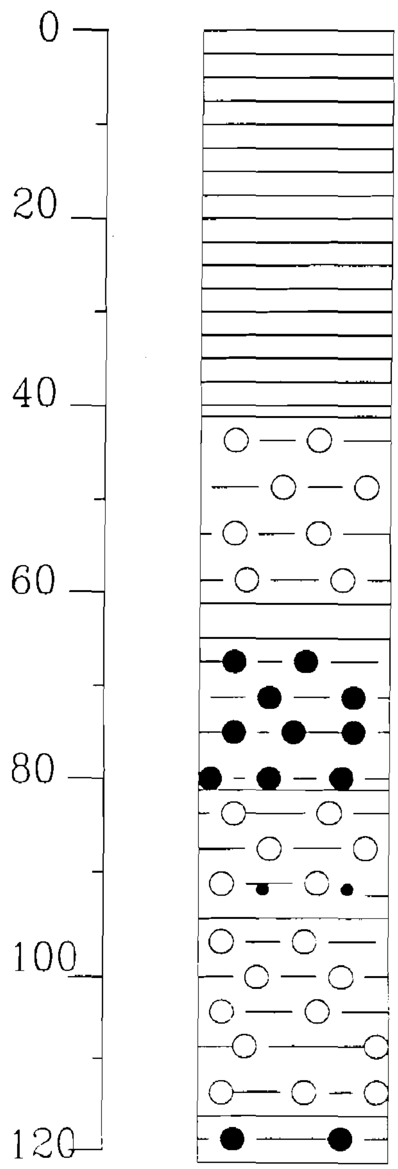
Muddy sand - olive gray with occasional granules.

Medium to coarse gravelly sand - olive gray

CORE: DD-DC-4

LOCATION: Dover Downs

Depth (cm)



Description

Mud with some sand - dusky yellowish brown/black. Abundant organic matter. Unit becomes denser towards base. Rare coarse sand and granules.

Sandy mud - black/dusky yellowish brown.

No recovery

Muddy sand - olive gray to brown with some granules.

Fine sand with some mud - olive gray scattered granules and pebbles, very dense

Sandy mud with rare gravel and some plant matter. Completely unsorted

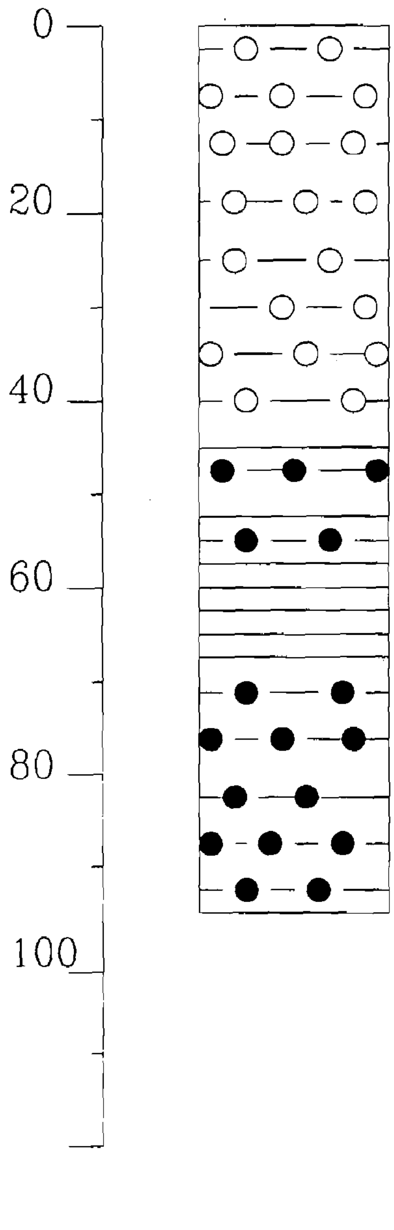
Muddy sand - light olive gray, with abundant pebbles and granules.

CORE: DD-DC-5

LOCATION: Dover Downs

Depth (cm)

Description



Sandy mud - dusky yellowish brown

Muddy sand - brown to black, with occasional granules

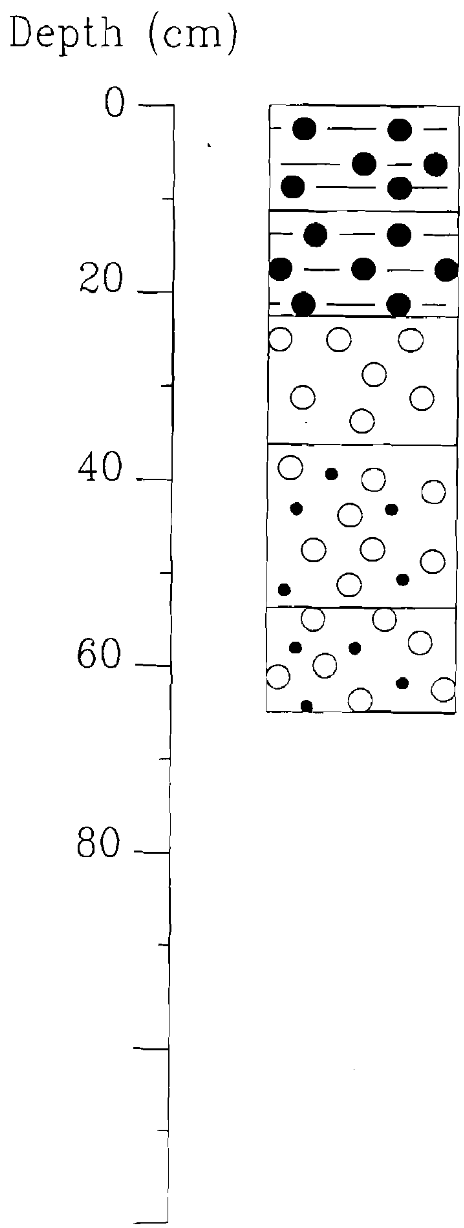
Muddy sand - brown, with occasional granules and pebbles

Mud - olive gray, with abundant fine sand

Muddy sand - grades from dark brown to light olive gray

CORE: DD-DC-6

LOCATION: Dover Downs



Description

Muddy sand - black/dusky yellowish brown. Abundant organics

Muddy medium to coarse sand - brown

Medium to coarse sand - pale orange brown

Same as above - with scattered pebbles

Same as above - with occasional dark rust colored and light cream colored mottles

APPENDIX V

GLOSSARY

Aboriginal - Prehistoric peoples in North America.

Adaptation - A change in behavior of an individual or group in adjustment to new or modified cultural surroundings.

Aeolian - Wind blown sediment deposits. For example, sand dunes are aeolian deposits.

A-Horizon - The top layer of soil, consisting of organic humus, characterized by the downward movement of water; also called zone of leaching.

Alluvium - Deposits of gravel, sand, and soil which are transported by flowing water.

Archaeology - The study of the people of the past through the recovery and analysis of the artifacts they left behind and their context.

Artifact - Any object shaped or modified by people, or as a result of human activity.

Assemblage - The array of contemporaneous objects and associations found at an archaeological site.

Basal - Reference to the base of a projectile point.

Base camp - A prehistoric dwelling site for hunter-gatherers from which resource procurement forays are made.

Bay/Basin Feature - Also known as whale wallows, these shallow fresh-water ponds, thought to have been formed during the end of the Pleistocene, represent a favored prehistoric settlement location.

B-Horizon - A soil layer characterized by the accumulation of material leached downward from the A-Horizon above; also called zone of accumulation.

Biface - A stone tool that has been flaked on both sides.

Billet - A club like rod made of anything but stone (usually antler) that is used to remove flakes in the process of making stone tools.

Bi-Polar Core Technology - Expedient technology for producing flakes using unprepared amorphous cores. The core is set on an anvil and randomly struck with a hammerstone or billet to produce flakes.

Boreal - A forest and tundra environment (e.g., North Temperate Zone and Arctic region).

B. P. - Years before present, which has been standardized at A.D. 1950.

Cache - A collection of artifacts and/or ecofacts which have been deliberately stored for future use.

Catchment - The area surrounding a habitation site from which resources are obtained.

C-Horizon - A soil layer composed of incompletely weathered parent material.

Colluvium - A loose deposit of rock debris accumulated at the base of a cliff or slope.

Core - A piece of stone (lithic material) from which other pieces of stone are flaked off to make artifacts.

Cortex - The outer layer or natural surface of stone that has been exposed to weathering.

Cretaceous Geologic Period - The third period of the Mesozoic era characterized by the development of flowering plants and the disappearance of dinosaurs.

Cryptocrystalline - Having an indistinguishable crystalline structure. Hard, compact, fine-grained rocks formed almost entirely of silica and containing the characteristic of concoidal fracture (e.g., chert, jasper, chalcedony).

Culture - The nonbiological mechanism of human adaptation, and rules, traditions, and customs of a particular society.

Datum - A fixed point from which all archaeological excavation levels are measured. A datum line is a line of fixed elevation secured by nails in the balk of a test square to help in making a scaled drawing of the balk face.

Debitage - The unused stone flakes produced in the process of manufacturing stone tools.

Deciduous - Leaf bearing trees that shed in autumn.

Decortication - Removal of the cortex from a piece of stone.

Denticulate - Finely toothed; minutely dentate. A tool with small (toothlike) projections on the edge.

Detritus - Particles of rock or other material worn or broken away from a mass, as by the action of water or glacial ice; any disintegrated material; debris.

Diachronic - Referring to two or more reference points in time. Method of investigation which examines change over time.

Diagnostic - Artifact with identifying traits that categorize the item to a specific time period.

Difference-of-Means Test - A statistical test that determines if the means (averages) of variables, or measurements are different.

Difference-of-Proportion Test - A statistical test that measures the degree of difference between samples from two different populations of things.

Distal (End) - The pointed end of a projectile point.

Dorsal - Facing side; outer surface.

Early Stage Biface Reject (ESBR) - Bifacially modified preform "rejected" in the early stages of manufacture by a flintknapper because of breakage, material flaws, or other attributes that would inhibit its completion into a usable stone tool.

Ecofact - The nonartifactual remains found in archaeological sites such as seeds, bones, and plant pollen.

Ecotone - An ecological community of mixed vegetation formed by the overlapping of adjoining communities.

Edaphic Factors - The factors in an environment which are due to the physical, chemical, and biological characteristics of the soil.

Estuary - A semi-enclosed body of water where fresh and salt water mix due to the action of currents and tides.

Facie - A stratigraphic body distinguished from others by appearance or composition.

Fall Line - A transition zone from the Piedmont Uplands to the flatter Coastal Plain.

Feature - Any soil disturbance or discoloration that reflects human activity or an artifact that, being too large to remove from a site, normally is recorded only; for example, house, storage pits, etc; can also be a very dense collection of artifacts: for example, a lithic chipping feature.

Fire-cracked Rock - A rock that has fractured and/or discolored due to exposure to heat.

Flake - A piece of waste material produced during the manufacture of stone tools.

Flotation - The use of water suspension to recover tiny plant and bone fragments from archaeological sites.

Fluvial - Produced by the action of flowing water.

Fusion/Fission Social Organization - Large (fused) social groups consisting of sets of individual nuclear families that inhabited macroband base camps during the season when those areas contained rich resources. When resources became depleted, macrobands would break (fission) into smaller units and move to different resource settings to inhabit microband base camps.

Geomorphology - The geologic study of the configuration and evolution of land forms.

Hammerstone - A rounded stone to be used as a hammer (in the production of stone tools). Sometimes grooved for hafting to a handle; usually ungrooved, however, it has a variety of forms ranging from a crudely shaped sphere to a finely ground ovoid with a battered end.

Historic - The time period after the appearance of written records. In the New World, this generally refers to the time period after the beginning of European settlement at approximately 1600 A.D.

Holocene - Geologic division of time (Epoch) ca. 10,000 - 0 B.P. The latest division of the Quaternary period, which commenced around 10,000 B.P.

Hydrology - The scientific study of the properties, distribution, and effects of water on the earth's surface, in the soil and underlying rocks, and in the atmosphere.

Hydrophyte - A plant that grows in and is adapted to an aquatic or very wet environment.

Illuviation - The deposition in an underlying soil layer of colloids, soluble salts, and mineral particles leached out of an overlying soil layer.

In Situ - In the original place.

Interface - A surface regarded as the common boundary of two bodies or spaces.

Isostatic Rebound - The upward recovery of the earth's crust following the removal of a load, such as a glacier.

Keel - A ridge down the center of a stone tool that is caused by the termination flakes which were removed from the edge; also termed carinate.

Lacustrine - Reference to a glacial lake deposit.

Laminae - A thin layer of sediment that is typically 0.05 to 1.0 mm thick.

LANDSAT - Refers to images obtained by earth-orbiting satellites. The LANDSAT satellites have sensors that scan the surface of the earth continuously as the satellite circles the earth. Readings of brightness in several wavelengths (colors) of light are radioed to receiving stations in a form that can be analyzed by computer.

Lateral - Relating to or situated on or at the side.

Late State Biface Reject (LSBR) - Bifacially modified preform "rejected" in the later stages of manufacture by a flintknapper because of breakage, material flaws, or other attributes that would inhibit its completion into a usable stone tool.

Lithic - Pertaining to or consisting of stone.

Loam - A loose soil composed of roughly equal parts of silt, clay and sand, especially a kind containing organic matter and of great fertility.

Locus - A defined archaeological site or testing location.

Loess - A buff to gray, fine-grained, calcareous silt or clay, thought too be a deposit of wind-blown dust.

Macro-band Base Camp - For a hunter-gatherer society, an archaeological site one hectare or larger in area characterized by a wide variety of tool types, abundant ceramics, semi-subterranean house structures, storage pit features, and abundant debitage from tool manufacture and reduction.

Marl - Soft and unconsolidated calcium carbonate, usually mixed with varying amounts of clay or other impurities.

Mega Fauna - A number of species (now extinct) of large mammals including mammoths and mastodons.

Mesic Forest - A vegetation pattern characterized by mixed wet- and dry-adapted plant species, such as oak and hemlock forests.

Micro-band - A component of macro-band, perhaps one or two extended families, which periodically operates independently of the macro-band group.

Microenvironment - A characteristic biotic assemblage, often exploited by a distinctive ecological niche.

Midden - Refuse deposits resulting from human activities, generally consisting of soil, food remains such as animal bone and shell, and discarded artifacts.

Moh's Scale of Hardness - Ten minerals designated as standards of hardness, with 1 being the softest and 10 the hardest. The minerals are as follows: 1. Talc; 2. Gypsum; 3. Calcite; 4. Fluorite; 5. Apatite; 6. Orthoclase; 7. Quartz; 8. Topaz; 9. Corundum; 10. Diamond

Neritic - The waters and deposits of a shoreline.

Palustrine - Pertaining to material deposited in a swamp environment.

Palynology - The scientific study of pollen and other spores and their dispersal, and applications thereof.

Pedestrian Survey - The walking and collecting from the surface of an archaeological site without the excavation of subsurface units.

Pedogenic - Referring to the development of soils in place.

Physiographic Zone - Regions or areas that are characterized by a particular geography, geology, and topography.

Piedmont Region - An area of gently rolling to hilly land lying between the Appalachian Mountains and the Atlantic Coastal Plain. The division between the Piedmont Region and the Coastal Plain is marked by the Fall Line.

Pleistocene - Geologic division of time (Epoch) ca. 16,000,000 - 10,000 B.P. A division of the geologic Quaternary Period, which began around 2.3 to 3 million years ago and is associated with rapid hominid evolution from Australopithecinae to Homo sapiens sapiens.

Plow Zone - In a plowed field, the upper layer of organic soil which is continually reworked by the plow. In the Middle Atlantic region this is about 8-12 inches thick.

Pollen - The fine, powderlike material produced by the anthers of flowering plants (functioning as the male element in fertilization) by which these plants may be identified.

Post Hole - A hole dug in the ground into which a post is placed.

Post Mold - The organic stain in the ground which is left by a decayed wooden post. A post mold stain may occur inside of a post hole stain on an archaeological site.

Prehistoric - The time period before the appearance of written records. In the New World this generally refers to indigenous, pre-European societies.

Primary Lithic Resource - Outcrops of workable stone that are found within the matrix of their original formation.

Procurement Site - A place that is visited because there is a particular item to acquire; i.e., lithic outcrops; hunting locales.

Projectile Point - Strictly speaking, a biface attached to the head of an airborne item of weaponry, like an arrow or a thrown dart; frequently used indiscriminately when referring to any biface.

Provenience - The exact location where an artifact was found on an archaeological site.

Proximal - Referenced here as the "shaft end" of a projectile point. Near the center part of the "body" or point of origin or attachment; the platform end.

Quarry Site - A site located at either a primary or secondary outcrop of high-quality lithic material used in the manufacture of stone tools.

Quarry Reduction Station - A place where material obtained from a quarry site such as large flakes, cores and very early stage bifaces were taken for further reduction into smaller primary-thinned bifaces.

Ranked Society - A society in which there is unequal access to the higher status categories; many people who are qualified for high status positions are unable to achieve them.

Scalar Flakes - A irregular overlapping use-wear pattern on stone tools consisting of fishscale-like flake scars.

Secondary Lithic Resource - Cobbles and boulders of variable size that have been removed from the matrix of their original formation, transported by alluvial or glacial agents, and redeposited at a new location which may be quite distant from their original source.

Sediment - Particles of rock and mineral material laid down through the action of wind and water.

Sherd - A piece of broken pottery.

Site - A place with evidence of human occupation.

Soil Horizon - Soils are divided in 3 horizons (A, B, and C), which reflect different kinds of chemical and physical processes that have resulted from changing climatic conditions.

Staging/Processing Site - A temporary camp where preparations are made for another operation such as a hunting foray.

Stemmed Point - A projectile point that has an obvious hafting element for attachment to a shaft.

Stratigraphy - The examination of the soil layering on an archaeological site; the characteristics of each individual stratum and its relationship to others in the sequence is critical to understanding the temporal and spatial characteristics of the site.

Strata - The various layers of human or geological origin which comprise archaeological sites.

Striations - Microscopic lines that show patterns; usually a thin line or band, especially one of several that are parallel or close together.

Subsoil - Sterile, naturally occurring soils not changed by human occupation.

Surface Collection - Act of walking along a surface such as an open field or plowed field, and collecting artifacts seen on the surface of the ground.

Synchronic - Method of investigation which examines a single period in time.

Tertiary Geologic Period - The first period of the Cenozoic era, extending from the Cretaceous period of the Mesozoic era to the Quaternary period of the Cenozoic era, characterized by the appearance of modern flora and of apes and other large mammals.

Tool Kit - A collection of artifacts from a sealed context within a site interpreted as being designed for a specific function.

Transect - A single strip of land crossing an area possibly containing an archaeological site. Archaeologists may search a transect rather than survey the whole area.

Topography - The surface physical features and configuration of land.

Transect Sampling - A means of archaeological research in which the sampling element is a square or rectangular grid.

Transverse Fracture - A fracture or break running diagonally across a point or biface.

Topography - The surface physical features and configuration of land.

Utilized Flake - A waste flake from stone tool manufacture used, without modification, as a tool for cutting or scraping. Utilization often damages the sharp edges of a flake.

Ventral - The underside of a piece of stone material; the plano side or inner surface.

Xeric Forest - A vegetation pattern characterized by relatively dry-adapted plant species, such as grasslands and forests of oak and hickory.

Xerophyte - A plant that grows in arid conditions.

STATE OF DELAWARE
DEPARTMENT OF TRANSPORTATION
P.O. BOX 778
DOVER, DELAWARE 19903

THOMAS R. CARPER
GOVERNOR

APPENDIX VI

PUBLIC INFORMATION HANDOUT: PHASE III EXCAVATIONS AT SITE 7K-C-360, DOVER, DELAWARE

The 7K-C-360 site was identified during the Phase I/II testing of the Route 13 Corridor by the University of Delaware Center for Archaeological Research. Site 7K-C-360 is located on an unplowed sandy knoll in a wooded area in northeastern Kent County, Delaware. To the east and west, the knoll drops off steeply to seasonally inundated low swampy areas.

Excavations at the site have showed that it is unplowed and has produced Early and Middle Archaic artifacts in good stratigraphic context. The association of features with the Early and Middle Archaic artifacts, the intact stratigraphic context of the artifacts and features, and the presence of local freshwater wetlands which are good sources of information on local paleoenvironments all combine to make Site 7K-C-360 likely to yield important information on the poorly known Early and Middle Archaic Periods.

Early and Middle Archaic sites have been identified previously on the Delmarva Peninsula, but all of the known sites, with the exception of the Dover Downs site, are disturbed surface sites with no stratigraphic context. Prior studies of Early and Middle Archaic lifeways and adaptations have suggested that there is considerable continuity running from the Paleo-Indian Period (ca. 12,000 - 10,5000 B.P.) through the Early Archaic Period (ca. 10,500 - 8500 B.P.), into the Middle Woodland Period (ca. 8500 - 5000 B.P.). This continuity of lifeways is related to adaptations to the spruce and hemlock forests which dominated the environments of the Delmarva Peninsula during this time period. Because Site 7K-C-360 contains both Middle and Early Archaic components, it will be possible to compare the uses of the site during these two time periods to test ideas about continuities in prehistoric adaptations and lifeways.

The presence of chipping features produced by the manufacturing of stone tools will allow the study of tool production strategies. The presence of hearth features will allow the possible recovery of prehistoric food remains and other ecofacts which will allow the study of prehistoric diets. Furthermore, the ecofacts from the site will provide data on the environments surrounding the site during the prehistoric past. Pollen and sediment cores can also be taken from the adjacent freshwater wetlands to study local environments and the combination of the ecofacts from the sites and the pollen data from local cores provides an excellent data base for the study of local paleoenvironments. Knowledge of these paleoenvironments during the time periods of the site's occupation will also enhance the study of continuities in prehistoric adaptations and lifeways.

DelDOT