8. Soils Tell of Site History

In addition to artifacts, people have left chemical traces on the site, and different parts of the site have experienced different natural histories.

From an early stage in the project, it was apparent that the site was not a single environmental setting. On the north side of the peninsula, features were located right under the leaf mold and most of the artifacts were found in very shallow levels. To the south, along White Marsh Branch, artifacts were found deeply buried. For answers of these differences, we sought the advice of a soil scientist. Foss came to the site August 10 and bored a series of test holes into the peninsula, on a line between the two drainages.

His interpretation of the site's soil history would contribute considerably to the final conclusions. His six boreholes (Figure ##) went as deep as two meters and identified as many as ten distinct soil horizons in some cases. In addition, he was able to examine some of the excavated units' profiles.

The soil profiles demonstrated that the two sides of the peninsula have experienced different natural histories, which might help account for the differences in artifact distributions.

Foss findings

Figure 51 gives the results of the auger descriptions of soil profiles examined at the site. The soils were developed in alluvial sediments with numerous discontinuities evident in the soil profiles. Profiles 3-5 showed abundant strtification in the lower

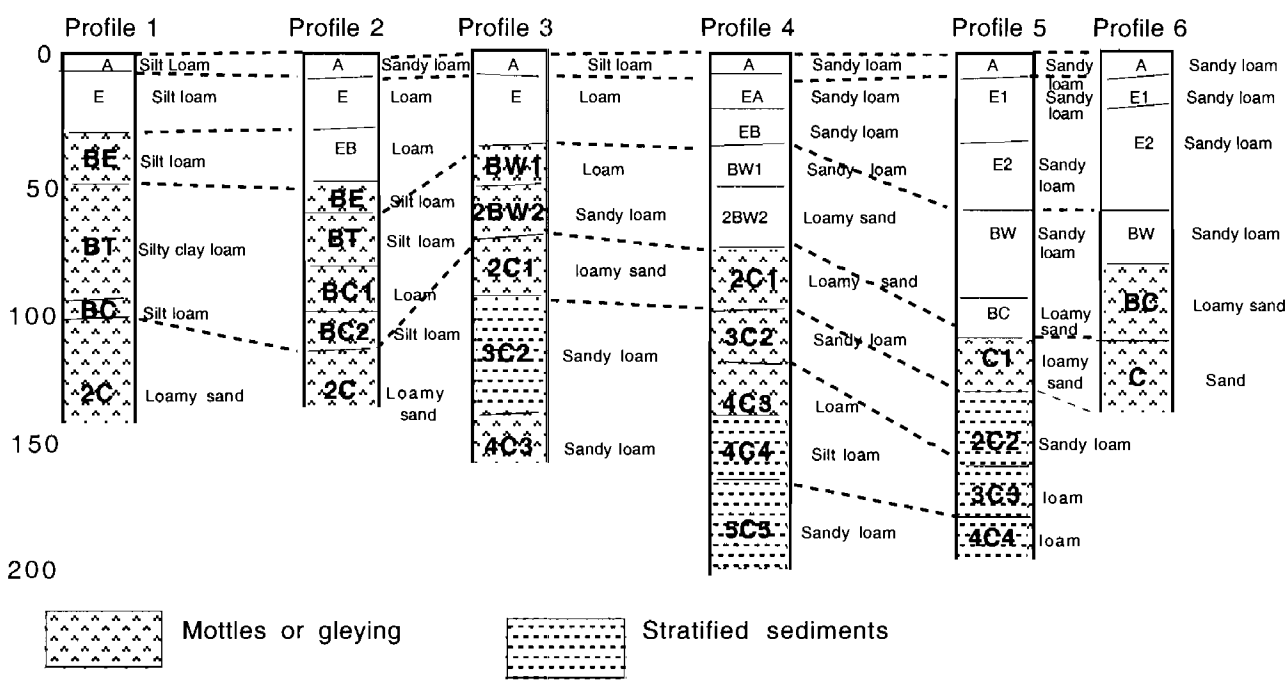

Figure 54: Composite profile of the soil samples analysed by Foss

horizons. Two major types of alluvial sediments were noted in the traverse; these were silty to loamy sediments and sandy sediments. The upper meter of profiles 1 and 2 and the upper 50 cm in profile 3 were developed in silty to loamy sediments, while profiles 4-6 were dominated by sandy sediments. distribution of sandy sediments in the ridge position is similar to levee deposits and the silty soils would most likely be developed in overbank deposits farther from the active stream. Profile 3 had a thinner silt cap compared to profiles 1 and 2 which probably is related to the fact that profile 3 is at the head of a small drainageway and this resulted in erosion of the silts from this profile. Differences in elevation at the sites may also have contributed to sedimentation changes from silts to sands.

An important characteristic of the soils at Beech Ridge is the drainage mottling (redoximorphic features) that occurred in each profile. In the lower elevations and in the silty soils, the mottling occurred at depths around 50 cm, but in the higher elevations and in the sandy soils the mottling usually occurred at depths below 1 meter (in Profile 4 at 75 centimeters). The mottling indicates the heighth of the high water table in the profiles; this usually occurs in the spring in Delaware. soil drainage is an important characteristic that influences the potential habitation of a site.

Soil development noted in the traverse ranges from a moderately-well developed argillic horizon in Profile 1 to a well-developed cambic horizon in profiles 3-6. The ranges in soil development are related to the texture of the original sediments, drainage profiles, and perhaps age of the soil materials. The argillic horizons in the silty soils in profiles 1-2 are moderately and weakly developed, respectively. The argillic horizon in these profiles, from preliminary data, indicates a weathering period of at least 8,000 to 10,000 years. The cambic horizons in profiles 3-6 appear to indicate a inimum of 6,000 to 7,000 years of weathering. These weathering rates may be adjusted after examining profiles in excavations to more carefully evaluate pedogenic features that are not possible to evaluate with auger samples (for example, clay coatings, structural aggregates). No buried horizons or old surfaces were noted at depths below 1 meter.

SOIL CHEMISTRY

Regarding the overall soil chemistry, Foss offered the following observations.

Soil chemistry has been used in the interpretation of archæological sites for over five decades, with many of the early studies related to elements like phosphorous that are enriched at archæological sites compared to off-site locations. In recent years soil chemical properties have been combined with morphological data and landscape characterization to provide a more complete picture of the impact of habitation on soil properties. In addition, modern methods and instrumentation (e.g. inductively coupled plasma atomic emission spectrometer-ICAP) have also encouraged the used of chemical properties to interpret past activities at archæological sites (Lewis et al. 1993).

Elements that have proved valuable for archæological interpretation include phosphorous for indicating intensity of occupation of a site. Phosphorous is especially adapted for archæological studies because of the numerous sources for this element and its resistance to movement in soil because of phosphorous fixation to clay, organic matter, iron compounds, and formation of chemical complexes.

Organic matter, of course, has also been useful in many archæological studies as evidence for diet, climate, landscape reconstruction, identification of buried soils, post molds, hearths, storage pits, and animal burrows (Stein, 1992).

Those elements that are recycled by vegetation growing on the soil are useful in determining former surfaces. Elements are taken up by plants and then released by decaying organic matter. Some of the elements used to

determine previous soil surfaces include barium, manganese, strontium, magnesium, and heavy metals such as zinc, copper, and nickel (Foss et al. 1995).

The concentration of lead in soil has been used on a number of Roman sites to indicate human contamination of soils (Essington and Foss, 2000).

The soils at the Beech Ridge site were extremely to strongly acid with pH values ranging from 4.2 to 4.8. The pH values are typical for Coastal Plain soils in Maryland [and Delaware] that have not received additions of agricultural lime as a soil amendment. These acid soils would also have low amounts of basic ions like calcium, magnesium, and sodium.

Soil organic matter on the surface ranges from 1.7 to 7.4%, but drops rapidly in the subsoil to values generally less than 0.5% (loss-on-ignition method). Phosphorus values of surface soils are also low (generally <10 mg/kg) throughout the site.

Figure 57 shows the phosphorous content of the soil surface throughout the site; the increases, e.g. Unit 23, are probably related to higher activity areas. The variable calcium concentration on the surface shown in Figure 59 are also related to human activity and the amount of disturbance of soil surfaces.

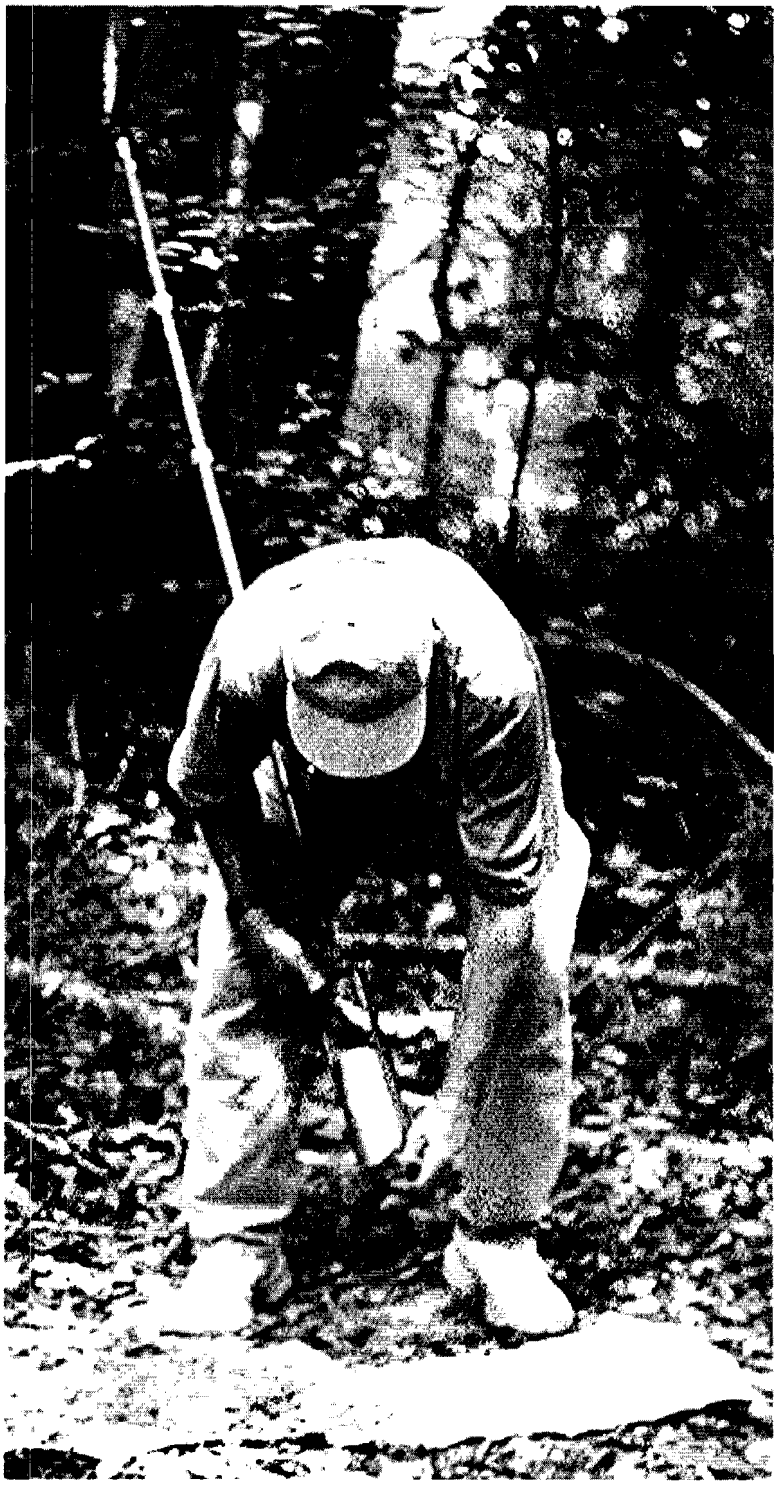

Figure 56: Dr. John Foss removes a sample from his auger in the course of the soil survey. Soil samples from the auger were laid out in sequence on a piece of canvas, reproducing the succession of layers of soil layers below.

DETAILED SOIL CHEMISTRY OF SPECIMENS FROM OUTSIDE THE EAST PIT FEATURE

Bag Label	M1-K (mg/kg)	M1-Ca (mg/kg)	M1-Mg (mg/kg)	M1-Mn (mg/kg)	M1-Zn (mg/kg)	M1-Cu (mg/kg)	M1-Fe (mg/kg)
Unit 52 deep test hole	12.7	6.0	44.9	0.85	0.15	0.22	58.69
Unit 58 Fill, 45-55 cm	21.9	8.5	3.8	0.99	1.38	0.29	35.63
Unit 62 Feature Fill 35 cm	9.2	11.8	3.1	3.67	0.47	0.21	25.43
Unit 62 Feature Fill "B/C"	12.8	9.6	3.3	2.58	0.39	0.21	24.19
Unit 63 Feature Fill 41 cm	9.0	8.2	2.4	2.47	0.61	0.24	21.73
Unit 64 Feature Bottom	13.7	14.3	4.8	0.77	0.87	0.34	40.73
Unit 65 Level 2a,7-12 cm	418.8	24.3	6.8	3.01	1.69	0.32	66.51

Bag Label	pH	Buffer pH	OM(%) byLOI	M1-P (mg/kg)
Unit 52 deep test hole	4.5	7.65	<0.1	0.9
Unit 58 Fill, 45-55 cm	4.4	7.62	0.1	1.3
Unit 62 Feature Fill 35 cm	4.5	7.61	0.6	9.1
Unit 62 Feature Fill "B/C"	4.4	7.62	0.4	6.2
Unit 63 Feature Fill 41 cm	4.5	7.68	0.6	8.6
Unit 64 Feature Bottom	4.3	7.67	0.2	2.3
Unit 65 Level 2a,7-12 cm	4.2	7.13	5.6	3.9

Bag Label	WB-OM (%)	EPA3051 (mg/kg)	PEPA3051 (mg/kg)	BaEPA3051-Sr (mg/kg)
Unit 52 deep test hole	0.31	114.50	28.40	3.84
Unit 58 Fill, 45-55 cm	0.27	145.39	48.52	6.29
Unit 62 Feature Fill 35 cm	0.97	226.74	51.10	5.96
Unit 62 Feature Fill "B/C"	0.84	162.88	41.37	5.84
Unit 63 Feature Fill 41 cm	1.08	221.63	53.99	7.66
Unit 64 Feature Bottom	0.61	100.26	39.39	3.78
Unit 65 Level 2a, 7-12 cm	5.10	174.12	80.27	6.19

DEFINITIONS:
OM by LOI: Organic matter by loss on ignition
WB-OM: Organic matter by Walkley Black (dischromate oxidation)
EPA3051: Refers to the EPA 3051 extraction solution for these elements

"ROUTINE" SOIL CHEMISTRY FOR THE GENERAL SITE

As illustrated on the maps in this chapter

Source on Site	U/D BAG #	pH	Buffer pH	OM (%) by LOI	M1-P (mg/kg)	M1-K (mg/kg)	M1-Ca (mg/kg)	M1-Mg (mg/kg)	M1-Mn (mg/kg)	M1-Zn (mg/kg)	M1-Cu (mg/kg)	M1-Fe (mg/kg)
Pt. E	822153	4.6	7.26	6.0	9.0	38.8	106.9	20.8	20.42	1.41	0.28	28.46
E+15W	822154	4.5	7.48	5.1	5.0	45.9	70.2	22.2	9.45	1.43	0.51	139.20
E+10W	822155	4.3	7.34	4.2	4.1	24.5	44.7	12.0	6.07	1.38	0.31	48.45
E+5W	822156	4.3	7.26	5.9	4.8	41.8	39.0	19.4	5.61	1.42	0.28	63.40
E+20W	822157	4.5	7.42	4.0	5.0	23.5	32.3	9.4	9.43	1.11	0.37	73.56
E+25W	822158	4.3	7.47	3.6	3.1	31.9	32.8	13.0	16.20	1.36	0.52	86.15
TU 50	822159	4.6	7.51	2.4	7.6	13.8	18.1	5.8	3.28	0.93	0.16	11.45
TU 14	822164	4.6	7.68	1.4	3.6	19.7	17.1	4.6	4.09	1.00	0.22	21.43
25W S15	822301	4.5	7.36	5.8	8.5	48.5	80.3	24.8	20.93	2.35	0.63	25.14
25W S10	822302	4.7	7.42	4.2	6.3	24.6	32.7	10.5	14.54	2.80	0.34	18.55
25W S25	822303	4.1	7.30	7.4	6.7	45.7	117.9	35.1	20.02	3.09	0.75	34.63
25W S40	822304	4.2	7.28	4.2	4.8	33.6	40.4	14.5	1.98	1.60	0.35	48.70
TU 24	822305	4.5	7.42	2.7	12.2	24.7	21.6	9.5	4.71	1.81	0.37	17.87
TU 27	822306	4.5	7.33	4.6	3.7	31.7	46.3	15.8	5.37	2.52	0.34	36.75
TU 48	822307	4.4	7.38	3.6	7.1	17.5	42.7	8.7	8.44	1.41	0.41	13.85
TU 42	822308	4.7	7.63	1.7	3.8	14.3	14.9	4.7	3.38	0.75	0.13	9.60
TU 38	822309	4.8	7.52	3.8	9.3	110.1	63.0	21.6	12.63	1.41	0.27	10.72
TU 12	822310	4.3	7.12	7.1	6.9	45.8	98.0	20.9	11.99	1.52	0.40	58.69
TU 44	822311	4.6	7.56	2.3	3.5	30.1	62.0	17.6	6.36	1.36	0.21	9.59
TU 21	822312	4.2	7.28	5.4	5.7	49.7	87.0	25.7	10.75	1.92	0.27	29.37
TU 39	822313	4.5	7.40	3.1	4.2	24.1	23.4	6.3	8.25	1.47	0.29	18.47
TU 26	822314	4.2	7.29	4.4	3.7	23.9	57.2	18.4	5.02	1.72	0.56	53.88

From the data available, it appears calcium values are higher on the soil surface (recycling) compared to lower in the profile; this increase in calcium on the surface has been noted in other areas in Maryland where the soil has not been plowed for a long period of time. The high values of iron in certain regions shown in Figure 60 may have resulted from disturbances bringing iron-enriched subsoils to the surface. An example of such disturbance would be deep pits, from which large quantities of soil would have been heaped on the ground surface.. Additional samples are needed for a thorough coverage of the site and sampling of a complete profile to determine iron distribution in the profile to fully evaluate these increases on the surface.