OVERBURDEN ANALYSIS USING ACID-BASE ACCOUNTING TECHNIQUES ON THE DIVIDE SECTION, TENNESSEE-TOMBIGBEE WATERWAY

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ABSTRACT

<u>Overburden Analysis Using Acid-Base Accounting Techniques on the Divide Section, Tennessee-Tombigbee Waterway</u>

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Overburden cores were examined from the Divide Section of the Tennessee-Tombigbee Waterway located in northeastern Mississippi. This non-coal application of acid-base accounting was unique because the material examined was Cretaceous deposits, whereas acid-base accounts have primarily been used on Pennsylvanian deposits mined for coal. Results of both acid-base accounting and sulfur fractionation procedures revealed which zones of the lower Eutaw formation contained pyritic materials. Although the amount of pyritic sulfur in the overburden was low, insufficient quantities of bases were present in most cases to counteract the acidity produced. Placement of the pyritic materials at or near the surface of disposal areas resulted in acid formation with subsequent vegetation failures and increased soil erosion. Where adjustments in liming rates were made according to acid-base accounting, sustaining vegetation was established and erosion prevented.

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INTRODUCTION

The Tennessee-Tombigbee Waterway is a Civil Works water resources project located in Alabama, Mississippi, and Tennessee. Construction began in the early 1970's and is nearing completion. A portion of this waterway is known as the Divide Section, most of which is located in Mississippi in Tishomingo County, with the remaining portion in Hardin County, Tennessee.

During construction of the Divide Section, accelerated erosion resulting from vegetation failure was noted in some of the disposal areas formed by fill material from excavation of the canal. Overburden analysis using acid-base accounting was employed to locate the acid-producing zone in the geologic section.

GEOLOGICAL CONSIDERATIONS

The excavated portion of the Divide Section of the Tennessee-Tombigbee Waterway is located solely within the northeastern part of Mississippi. The divide section follows a line from Pickwick Reservoir located in Tennessee to Bay Springs Reservoir in Mississippi. This section of the waterway transects the upper Cretaceous deposits of the Mississippi Embayment in the Gulf Coastal Plain.

Figure 1 (Corps of Engineer's geologic profile) depicts the geologic separations along the Divide Section of the waterway. In ascending order the geologic column consists of the Fort Payne formation, the Gordo formation, the McShan formation (intermittent), the Eutaw formation, and the recent alluvial mantle. Calcareous beds (chalks), which are commonly associated with Cretaceous deposits, are not present along the Divide Section of the waterway.

On the Tennessee Valley Divide, the ridgetops are composed of the Tombigbee sand member of the Eutaw formation (1). The Tombigbee sand member is described as a deep water deposited sand and is "more calcareous" than the typical Eutaw beds (2). Laboratory analyses of the Tombigbee sand member show that the weathered or upper portion contains a low level of pyrite.

The alluvial mantle is deeper both north and south of the divide. Two major separations in geology are dominant: the alluvium and the "lower Eutaw". These two deposits comprise the majority of the excavated material, and therefore are the primary materials available for plant growing medium. The overburden cores studied in this investigation deal only with these two deposits.

PROFILE BB'
(Along C/L of Waterway)

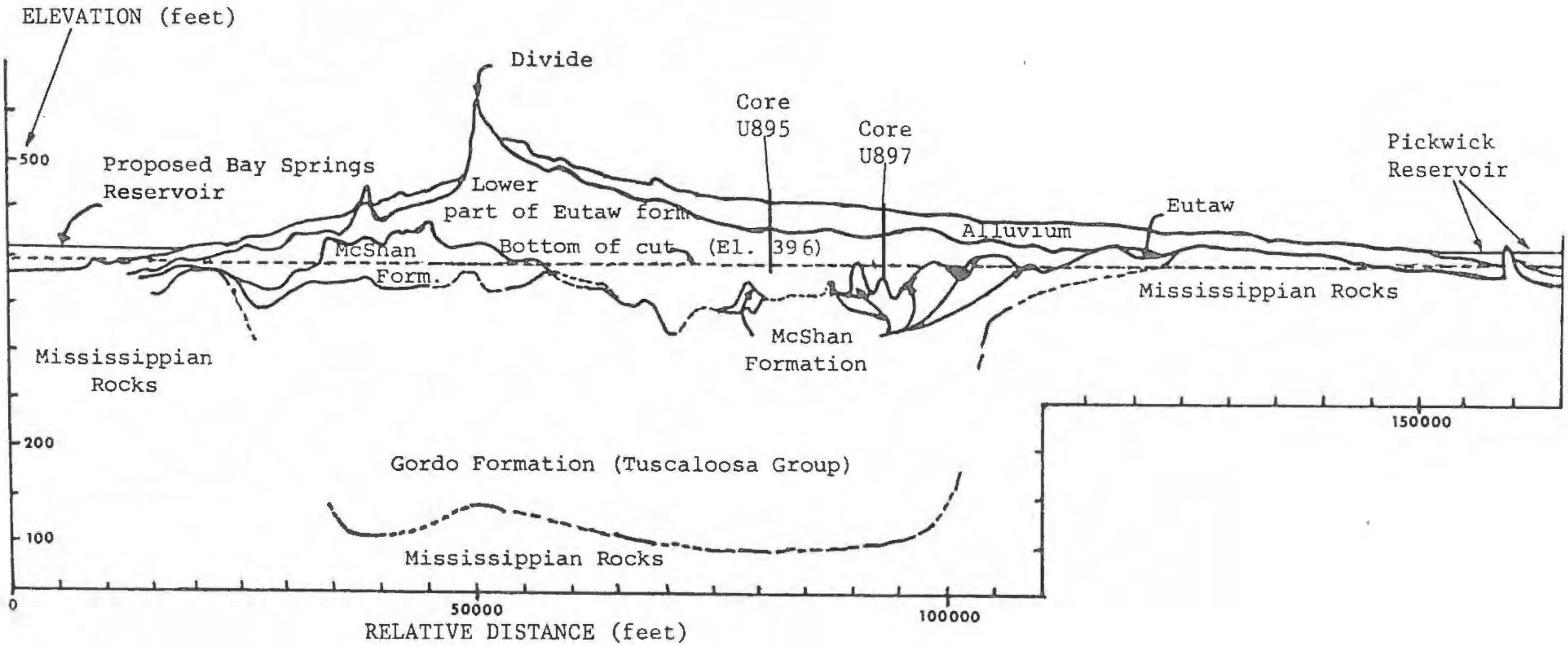

Figure 1
Geologic Cross-Section of the Tennessee Tombigbee Waterway Between
Bay Springs Reservoir and Pickwick Lake

MATERIALS AND METHODS

A two year study completed by Tennessee Technological University involved acid-base accounting and nutrient status of overburden cores and disposal areas of the Divide Section of the waterway, as well as test plot studies.

Five overburden cores from the Divide Section of the Tombigbee Waterway were sampled and logged by Army Corps of Engineers personnel and associated contractors. These cores were shipped to TTU where a detailed sampling log was completed as the cores were subsampled. Sample preparation and analyses were performed as outlined in Field and Laboratory Methods Applicable to Overburdens and Minesoils (3). All of the cores showed essentially the same trends throughout the geologic section with reference to acid-base accounting. Cores U895 and U897 were selected for this paper because they represented the most complete view of the geologic strata. These two cores were located 12,000 feet apart along the centerline of the waterway.

Samples from all five cores were selected for sulfur fractionation. The data presented in the acid-base account tables were calculated from total values because many of the samples were not fractionated. Pyritic sulfur values may be substituted for total sulfur for those samples which were fractionated to project a more accurate picture of acid producing potential.

RESULTS AND DISCUSSION

Overburden Core U895

The Acid-Base Account for core U895 is shown in Figure 2. The upper twenty-three feet of overburden, consisting of alluvium, are not potentially toxic but lack excess neutralizers. Additions of lime are necessary to sustain vegetative cover. Only one other zone of significant thickness is present which is suitable for use as plant growth medium. This is the overburden found between the depths of 40 to 55 feet. However, this material does not differ significantly from other more potentially acidic material in color or texture and is therefore difficult to distinguish in the field. If this material is used on the surface of new disposal areas, it should be limed using the Acid-Base Accounting data as a guide (see Table 1). Deficiencies as high as 90.9 tons calcium carbonate equivalent per 1000 tons of material are found in the rest of the overburden. Placement of this material on the surface of disposal areas must be avoided. If this material is deposited on the surface it should be "topsoiled" if possible, as large quantities of lime may be needed to sustain plant growth. The alluvium shows the lowest percentage of total sulfur in the core and represents the best source of non-pyritic "topsoiling" material. Less lime is needed to establish vegetation on the alluvium, thus reducing reclamation costs.

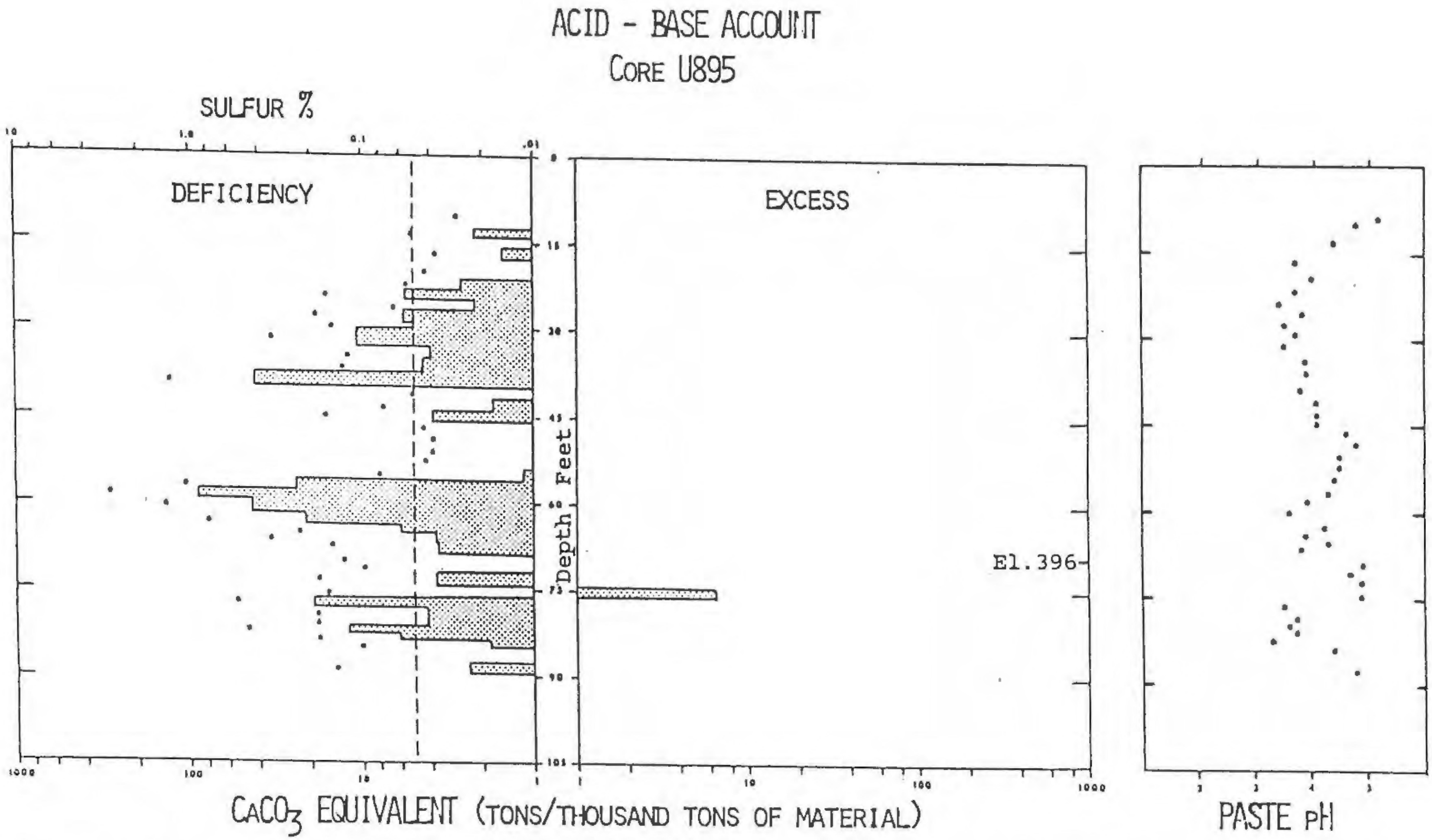

Figure 2. Acid-Base Account, Sulfur Content (dots) and saturated paste pH data of geologic section of Core U895 on the Divide Section - Tennessee Tombigbee Waterway. Shaded bars to the left of the center of the figure indicate the degree to which the acidity or potential acidity exceeds the neutralizing capacity of the material; shaded bars to the right indicate an excess of neutralizing potentials.

TABLE 1 ACID-BASE ACCOUNT OF CORE U895
Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
1	7.6-9.0	5.2	None	10YR5/6	.0099	.31	.08	.23	
2	9.2-10.7	4.8	None	2.5Y6/4	.0281	.88	.33	.55	
3	12.7-13.8	4.4	None	2.5Y6/2	.0504	1.58	- .66	2.24	
4	16.2-18.0	3.7	None	5Y6/2	.0380	1.19	- .37	1.56	
5	18.2-21.0	4.0	None	5Y6/2	.0415	1.30	.33	.97	
6	21.2-23.1	3.7	None	2.5Y6/2	.0565	1.77	- .90	2.67	
7	23.3-25.2	3.4	None	2.5Y6/2	.1639	5.12	- .66	5.78	
8	25.4-27.3	3.8	None	5Y6/2	.0645	2.02	- .16	2.18	
9	27.5-29.4	3.5	None	5Y6/2	.1850	5.78	- .16	5.94	
10	29.7-31.6	3.7	None	5Y5/2	.1566	4.89	- .16	5.05	
11	31.9-33.1	3.5	None	5Y5/2	.3453	10.79	.08	10.71	
12	34.1-35.3	3.9	None	5Y6/2	.1259	3.93	- .16	4.09	
13	36.3-37.5	3.9	None	5Y6/2	.1306	4.08	- .16	4.24	
14	38.0-39.9	3.8	None	5Y6/2	1.449	45.28	- .16	45.12	
15	40.1-42.0	4.1	None	5Y6/3	.0507	1.58	.82	.76	
16	42.1-43.9	4.1	None	5Y6/2	.0755	2.36	.61	1.75	
17	44.1-45.3	4.1	None	5Y6/4	.1699	5.31	1.35	3.96	
18	46.1-47.4	4.6	None	5Y6/3	.0436	1.36	1.35	.01	
19	48.2-49.9	4.8	None	5Y7/2	.0390	1.22	.86	.36	
20	50.1-51.85	4.5	None	5Y7/2	.0393	1.23	1.10	.13	
21	52.1-53.7	4.5	None	5Y7/2	.0425	1.33	.61	.72	
22	54.1-55.9	4.4	None	5Y6/2	.0793	2.48	1.35	1.13	
*23	56.0-57.8	4.3	None	2.5Y5/2	1.062	33.19	9.00	24.19	
*24	58.0-59.4	3.9	None	5Y5/2	2.960	92.50	1.60	90.9	
*25	59.75-61.5	3.6	None	5Y4/2	1.399	43.72	- .86	44.58	
*26	61.7-63.5	4.2	None	5Y5/2	.7820	24.44	3.07	21.37	
27					NO SAMPLE				
28	64.4-65.0	3.8	None	5Y5/3	.2350	7.34	1.35	5.99	

TABLE 1 ACID-BASE ACCOUNT OF CORE U895
Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
*29	65.2-66.4	4.3	None	5Y5/3	.3485	10.89	7.24	3.65	
30	66.9-68.7	3.8	None	5Y6/3	.1516	4.74	1.10	3.64	
31	68.9-70.7	4.9	None	2.5Y6/4	.1313	4.10	4.05	.05	
32	70.9-71.9	4.7	None	5Y6/3	.0982	3.07	2.22	.85	
33	72.1-74.1	4.9	None	5Y5/3	.1881	5.88	2.22	3.66	
34	74.3-76.1	4.9	None	5Y5/3	.1676	5.24	11.22		5.98
*35	76.3-77.7	3.5	None	5Y5/2	.5268	16.46	-3.21	19.67	
36	77.9-79.7	3.7	None	2.5Y7/2	.1806	5.64	1.36	4.28	
37	79.9-81.3	3.6	None	5Y6/3	.1847	5.77	1.48	4.29	
38	81.5-82.6	3.7	None	5Y5/3	.4632	14.48	2.22	12.26	
39	82.8-83.9	3.3	None	2.5Y7/2	.1842	5.76	- .27	6.01	
40	84.1-84.7	4.4	None	2.5Y6/4	.1064	3.33	1.48	1.85	
41				NO SAMPLE					
42				NO SAMPLE					
43	87.8-89.2	4.8	None	2.5Y6/4	.1449	4.53	2.10	2.43	

Overburden Core U897

The Acid-Base Account of core U897 is very similar to that of core U895 (see Figure 3). Note that both cores contain a zone with excess neutralizers at a depth of 75 feet. This zone is of insignificant thickness and it is also below the depth of excavation for the canal. The Acid-Base Account illustrates the same trend of total sulfur content and neutralizers as found in core U895, with zones of suitable plant growth medium found at Ø-23 feet and 44-56 feet. Again in this case, the alluvial mantle should be used for topsoiling because it is more easily distinguishable than the material from deeper in the section. Table 2 shows the degree of potential acidity in this core. Deficiencies as high as 57.7 tons calcium carbonate equivalent per 1ØØØ tons of material exist in the lower Eutaw material. Using the Acid-Base Account as a guide to liming materials from the alluvial mantle is the most logical course toward establishing successful vegetation on disposal areas.

Sulfur Fractionation

"Essential ingredients for the formation of pyrite are: sulfate, iron containing minerals, metabolizable organic matter, sulfate reducing bacteria, and anaeroby alternating with limited aeration" (4).

Pyritic sulfur (as reported in this study) includes the iron disulfide forms of pyrite, pyrrhotite, and marcasite. Pyrite was verified independently with the aid of a petrographic microscope as the form of inorganic sulfur in core samples on the Divide Section of the waterway (5).

The oxidation of pyrite generates sulfuric acid as follows:

$$4\ FeS_2 + 15O_2 + 14H_2O \longrightarrow 4\ Fe(OH)_3 + 8H_2SO_4$$

In nature, the reaction may proceed slowly through intermediate steps and depends on microbial activity, concentration of Fe(III), partial pressure of O_2, and other environmental variables (5).

The total sulfur from selected overburden samples was fractionated into organic, sulfate, and pyritic forms. Table 3 demonstrates that the percentage of organic sulfur is low, with an average concentration of only .Ø25%. Sulfate sulfur and pyritic sulfur dominate the sulfur fraction in these overburden samples. Organic and sulfate sulfur do not generate appreciable acidity, but pyritic sulfur will generate acidity in an oxygenated environment. If sufficient bases are not present to neutralize the acidity being produced, vegetation failure will occur.

Regression analyses were performed on the selected core samples to determine the relationship between total sulfur and pyritic sulfur (Figure 4). The relationship was found to be quadratic, and it was highly significant

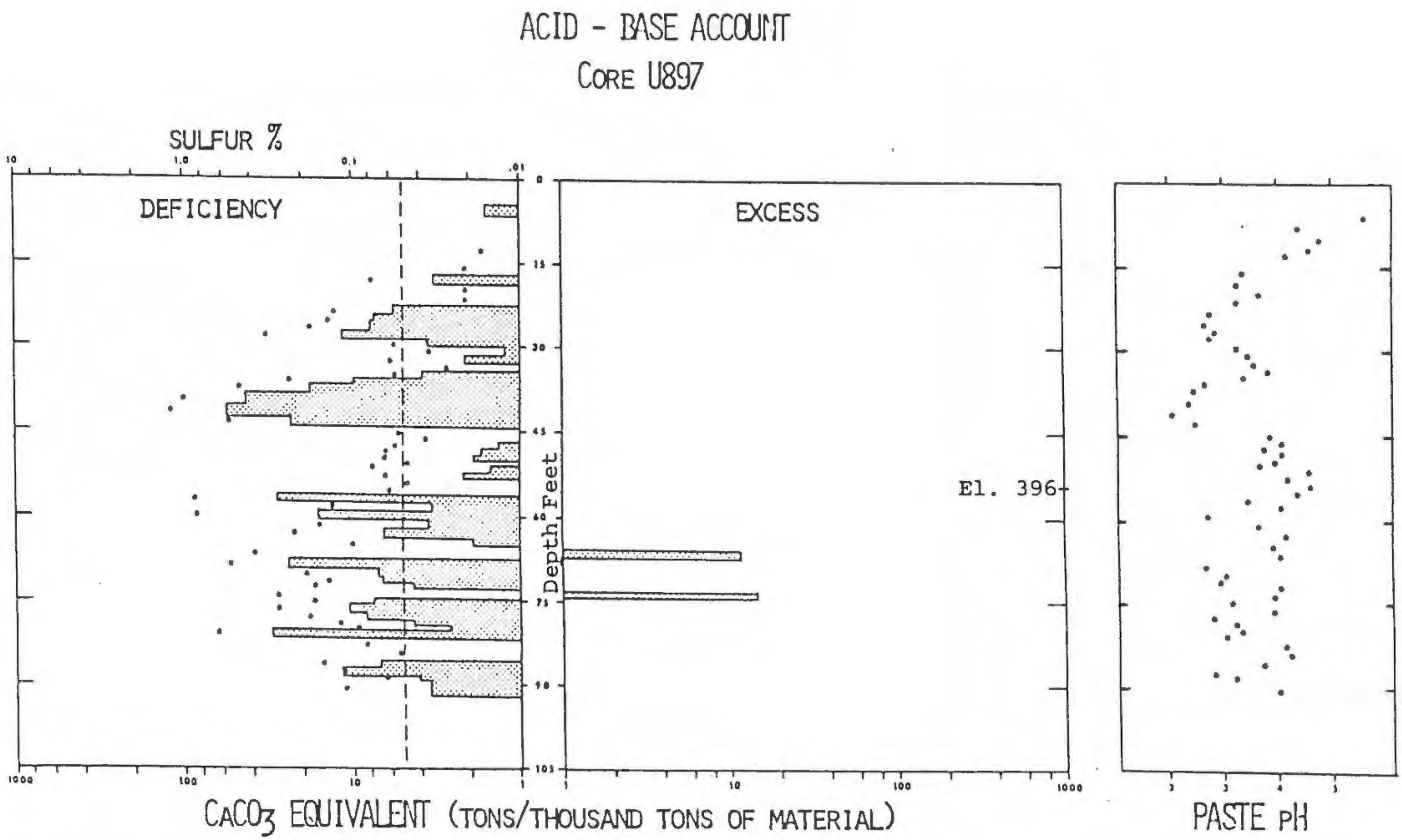

Figure 3. Acid-Base Account, Sulfur Content (dots) and saturated paste pH data of geologic section of Core U897 on the Divide Section - Tennessee Tombigbee Waterway. Shaded bars to the left of the center of the figure indicate the degree to which the acidity or potential acidity exceeds the neutralizing capacity of the material; shaded bars to the right indicate an excess of neutralizing potentials.

TABLE 2 ACID-BASE ACCOUNT OF CORE U897
Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	$CaCO_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
1	5.0-6.4	5.6	None	2.5Y6/4	.0026	.08	-1.55	1.63	
2	7.0-8.8	4.4	None	2.5Y6/6	.0064	.20	0.00	.20	
3	9.0-10.8	4.8	None	5Y7/2	.0071	.22	- .23	.46	
4	11.0-12.8	4.6	None	5Y6/2	.0094	.29	.66		.37
5	13.0-14.8	4.2	None	5Y6/3	.0172	.54	.22	.32	
6	15.0-16.6	3.4	None	5Y7/3	.0213	.67	.22	.45	
7	16.9-18.8	3.3	None	5Y7/2	.0795	2.48	- .89	3.37	
8	19.0-20.8	3.7	None	2.5Y7/2	.0218	.68	.22	.46	
9	21.1-22.8	3.3	None	2.5Y7/2	.0213	.67	- .22	.89	
10	23.0-24.2	2.8	None	2.5Y6/2	.1333	4.17	-1.22	5.39	
11	24.4-25.7	2.7	None	2.5Y6/2	.1434	4.48	-2.88	7.36	
12	25.9-27.5	2.9	None	2.5Y5/2	.1776	5.55	-2.21	7.76	
*13	27.7-28.8	2.8	None	2.5Y6/2	.3333	10.42	-1.55	11.97	
14	29.0-30.1	3.3	None	2.5Y6/2	.0588	1.84	-1.70	3.54	
15	30.3-31.8	3.5	None	5Y6/2	.0348	1.09	- .11	1.20	
16	32.0-33.1	3.6	None	5Y7/3	.0606	1.89	- .23	2.12	
17	33.3-34.4	3.9	None	5Y6/3	.0283	.88	1.28		.40
18	34.6-35.7	3.4	None	5Y6/3	.0570	1.78	-2.15	3.93	
19	35.9-36.9	2.7	None	5Y6/3	.2403	7.51	-2.38	9.89	
*20	37.1-38.6	2.5	None	5Y6/3	.4903	15.33	-3.29	18.62	
*21	38.8-40.65	2.4	None	5Y5/2	1.040	32.50	-10.54	43.04	
*22	40.8-42.65	2.1	None	5Y5/2	1.235	38.59	-19.15	57.74	
23	42.8-44.0	2.5	None	5Y5/3	.5481	17.13	-6.01	23.14	
24	44.2-45.8	3.9	None	5Y6/3	.0523	1.63	.82	.81	
25	46.0-47.1	4.1	None	2.5Y6/4	.0363	1.13	1.47		.34
26	47.3-48.3	3.8	None	5Y6/3	.0579	1.18	.45	1.36	
27	48.5-49.4	4.1	None	5Y5/3	.0643	2.01	.23	1.78	
28	49.4-50.2	4.0	None	5Y5/3	.0657	2.05	.11	1.94	
29	50.4-51.0	3.7	None	5Y6/4	.0470	1.47	.68	.79	

TABLE 2 ACID-BASE ACCOUNT OF CORE U897
Divide Section - Tennessee Tombigbee Waterway

Sample Number	Depth (feet)	Paste pH	Fizz	Munsell Color (powder)	%S	CaCO$_3$ Equivalent Tons/1000 Tons Material: Maximum (from %S)	Amount Present	Maximum Needed (pH7)	Excess
30	51.2-52.5	4.6	None	5Y5/3	.0775	2.42	.91	1.51	
31	52.7-53.8	4.2	None	2.5Y5/4	.0655	2.05	- .23	2.28	
32	54.0-55.0	4.6	None	2.5Y5/4	.0476	1.49	.80	.69	
33	55.2-56.2	4.4	None	2.5Y5/4	.0619	1.93	1.14	.79	
34	56.4-57.5	3.5	None	5Y5/3	.8894	27.79	- .46	28.25	
35	57.7-58.8	4.1	None	5Y5/3	.1364	4.26	.93	3.33	
*36	59.0-60.7	2.8	None	5Y5/3	.8573	26.80	10.72	16.08	
37	60.9-62.2	3.7	None	2.5Y5/4	.1622	5.07	1.49	3.58	
38	62.4-63.9	4.2	None	2.5Y5/4	.2209	6.90	.21	6.69	
39	64.4-65.5	4.0	None	2.5Y6/4	.1043	3.26	1.29	1.98	
40	65.7-67.2	4.1	None	2.5Y6/2	.3950	12.34	24.71		12.37
41	67.7-69.5	2.7	None	5Y6/3	.5398	16.87	-8.09	24.96	
42	69.7-70.7	3.1	None	2.5Y5/4	.1915	5.98	-1.06	7.04	
43	70.9-72.0	3.0	None	2.5Y6/6	.1442	4.51	-2.13	6.64	
44	72.2-73.1	4.1	None	2.5Y5/4	.1722	5.38	1.06	4.32	
45	73.3-74.5	4.0	None	5Y6/3	.2839	8.87	23.65		14.98
46	74.7-75.5	3.2	None	2.5Y5/4	.1754	5.48	-2.13	7.61	
47	75.7-77.0	4.0	None	2.5Y5/4	.2859	8.93	-1.92	10.85	
48	77.2-78.3	2.9	None	2.5Y6/4	.1878	5.87	-2.46	8.33	
49	78.5-79.5	3.3	None	2.5Y6/4	.1217	3.80	- .62	4.42	
50	79.3-80.1	3.4	None	2.5Y6/6	.0961	3.00	.41	2.59	
51	80.3-81.9	3.1	None	5Y5/2	.6488	20.28	-9.85	30.13	
52	82.3-83.8	4.2	None	2.5Y7/2	.0849	2.65	2.33	.32	
53	84.0-85.7	4.3	None	2.5Y7/2	.0517	1.62	1.85		.23
54	85.9-86.9	3.2	None	5Y6/3	.1552	4.85	-2.21	7.06	
55	87.1-88.6	2.9	None	2.5Y6/4	.1153	3.60	-8.21	11.81	
56	88.8-89.4	3.3	None	5Y7/4	.0647	2.02	-2.05	4.07	
57	89.6-91.8	4.1	None	2.5Y5/4	.1116	3.49	0.00	3.49	

*Sulfur Fractionated

TABLE 3
SULFUR FRACTIONATION OF SELECTED CORE SAMPLES
Divide Section - Tennessee Tombigbee Waterway

Core Number	Sample Number	Total S(%)	Pyritic S(%)	Sulfate S(%)	Organic S(%)
U 894 A					
	1	.3350	.1070	.2306	.0174
	2	.4206	.1657	.2372	.0177
	3	.3904	.1171	.2569	.0164
	4	.3386	.1133	.2253	**
	5	.7108	.4147	.2961	**
	6	.5090	.1405	.3685	**
	10	.1564	.0317	.1082	.0165
	12	.1099	.0313	.0684	.0102
	14	.4504	.2621	.1646	.0237
	15	.2278	.1437	.0579	.0262
	19	.5496	.1611	.3732	.0153
	23	.0704	.0530	.0111	.0063
	29	.1948	.1205	.0495	.0149
	30	.7495	.4496	.2717	.0282
	33	.5532	.2690	.2640	.0202
	34	.4136	.1995	.1936	.0205
	36	.3794	.1708	.1944	.0142
	37	.4931	.1788	.2983	.0160
U 895 A					
	5	.1348	.0572	.0704	.0072
	10	.3435	.2392	.0778	.0265
	11	1.280	1.1441	.0950	.0409
	13	.0518	.0339	.0118	.0061
U 895					
	14	1.449	1.3777	.0180	.0533
	19	.0087	.0030	.0015	.0042
	23	1.062	.8560	.1559	.0501
	24	2.960	--	--	.1281
	25	1.399	1.1641	.1560	.0789
	26	.7820	.6044	.1404	.0372
	28	.1940	.1116	.0659	.0165
	29	.3485	.1452	.1877	.0156
	35	.5268	.3020	.2069	.0179
U 896					
	17	.0070	**	.0070	**
	29	.4093	.2040	.1897	.0156
U 897					
	13	.3333	.2591	.0461	.0281
	20	.4903	.2232	.2488	.0183
	21	1.040	.5078	.5072	.0250
	22	1.235	.3733	.7981	.0636
	36	.8573	.3599	.4537	.0437

**Below Detection Limits

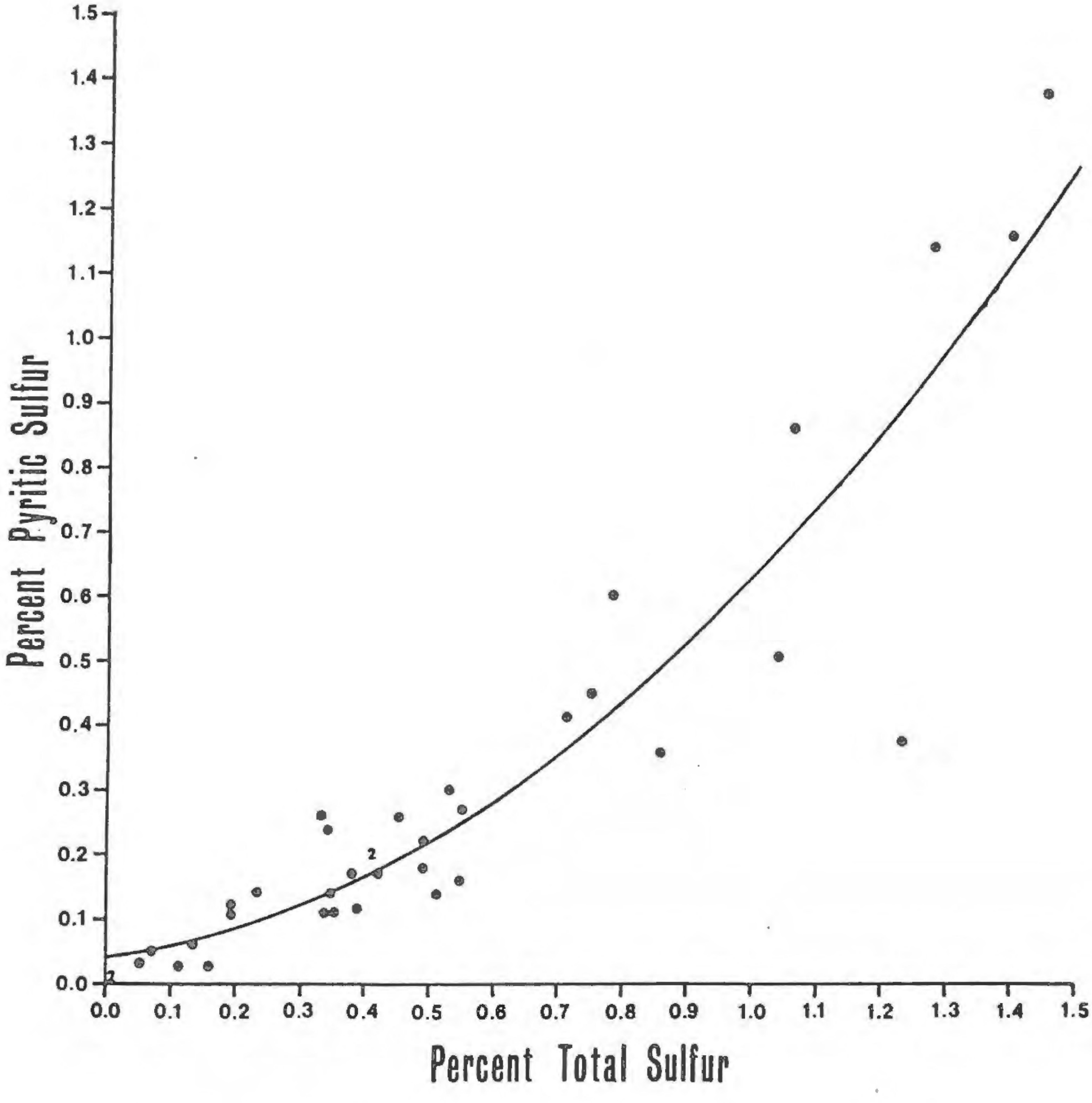

Figure 4. The relationship between total sulfur and pyritic sulfur in selected core samples from the Divide Section, Tennessee-Tombigbee Waterway.

(Pearson's r = .93). The equation is:

$$Y = .46 X^2 + .13 X + .04$$

where: Y = % pyritic sulfur
X = % total sulfur

The percentage of organic sulfur remained fairly constant at a low level throughout the entire range of total sulfur values. However, the quadratic relationship demonstrated by the curve in Figure 4 illustrates that pyrite occupies a greater percentage of the total sulfur when total sulfur values are high (85% at 1.5% total sulfur). When total sulfur is in the lower range (<0.6%), pyrite and sulfates are present in more equal quantities, with the sulfates tending to dominate. Acid-Base Accounting is usually calculated using total sulfur values, making the assumption that all sulfur is pyritic. Use of this procedure adds a margin of safety to the calculation of acidity produced from the oxidation of sulfur.

CONCLUSIONS AND RECOMMENDATIONS

Overburden analysis with Acid-Base Accounting completed on all deep earth excavations enables the analyst to evaluate the potential acidity and potential basicity of overburden materials before excavation. Acid-Base Accounting, a method used widely to characterize overburden in surface mining (6,7,8), is a reliable index of excess bases or potentially acidic materials and can be used to guide selective placement of these materials to insure a quality plant growth environment. Selective placement of overburden during excavation phases of construction is more economical than post-construction additions or amendments.

There are several advantages to be gained by the practice of selective placement:

1. Economic efficiency.
2. Simplification of treatments and practices for revegetation.
3. Assurance of consistent success in producing high quality permanent stands of vegetation without repeated treatments and seedings.

The correct identification of overburden materials in the field during excavation is important to assure that toxic material will not be deposited on the surface of disposal areas. For this reason, a grouping and identification of the overburden material is presented as a guide to selective placement.

The overburden from the Divide Section of the Tombigbee Waterway is divided into two distinguishable groups: (1) Low chroma materials (grays and blacks) including chromas from 0-3 on dry 60-mesh samples read from a Munsell Soil Color chart (the term "low chroma" is used by the USDA-SCS as chroma 2 or less); and (2) High chromas (browns, yellows, and red colors) with a chroma greater than 3 on dry 60-mesh samples read from a Munsell Soil Color chart.

The low chroma overburden is divided into two groups: (a) Alluvial materials that contain non-lithified wood, leaves, nuts, and bark of modern trees. This material is suitable as plant growth medium if selectively placed on the surface; (b) Low chroma overburden (Lower Eutaw) that contains lenses of non-lithified sand and fine mudstone interlayered with thin, sandy, partially-lithified sandstone and shales with visible pyrite, and lithified wood, some containing pyrite. This section also contains infrequent zones of high carbon material (carbolithic) with visible pyrite present. Where low chroma or carbolithic material is confirmed to contain pyrite either by taste, smell, visual observation or laboratory analysis, placement of this material on the surface or in the root zone should be avoided.

Although zones of lower sulfur and slightly higher calcium carbonate equivalence occur in some cases in the Lower Eutaw, field confirmation and selective placement may be difficult.

The high chroma overburden materials are found in the upper portion of the geologic section and include the native soil, yellow or brown sands and reddish yellow sands and loamy sands (upper portion of alluvium). This material is free from pyrite and will support plant growth on new disposal areas.

The total quantity of acceptable "topsoiling" material in the area to be excavated is estimated to be adequate for all needs. The contact between the alluvium and the Eutaw is comparatively easy to recognize by most field personnel. Each layer to be removed ,either for immediate placement or for later use, is thick enough for efficient excavation and handling without disruption of normal construction operations.

Selective excavation based on recognizable properties requires little planning and will prevent most of the complications resulting from vegetation failure.

Existing disposal areas that contain dead vegetation; areas of soil that look "wet" or "oily" in relation to the surrounding dry soil; low chroma nodules with visible pyrite; carbolithic materials (carbon); and lithified wood should be identified for immediate treatment. These properties can be determined in the field by the previously mentioned visual observations or by the bitter metallic taste and metallic smell. Acid-Base Accounting should be completed on these materials and adjustments to liming rates made accordingly. Topsoiling should be considered as an alternative, particularly when very high lime rates are called for.

In summary, preconstruction evaluation of overburden properties is the best course to adopt to insure a quality postconstruction environment. This is not always possible and overburden analysis may have to be completed during the construction process. If the latter situation prevails, adjustments in construction plans may be difficult. This was the case in the Divide Section of the waterway. Where adjustments were made in liming rates using Acid-Base Accounting data as a guide, sustaining vegetation resulted.

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