DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Descriptions of Backhoe Trenches Dug on New River Terraces between Radford and Pearisburg, Virginia, June 1981

by

Hugh H. Mills[1]

Open-File Report 85-474

This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.

[1]Department of Earth Sciences, Tennessee Technological University, Cookeville, Tennessee 38501

CONTENTS

ILLUSTRATIONS

INTRODUCTION

The New River is the only major stream that flows completely across the Appalachian highlands. Ironically, then, it appears to be one of the oldest streams in the Appalachians. Many authors have discussed and speculated on the evolution of the New River, but until very recently little attention has been given to the alluvial deposits of the river. An investigation of late Cenozoic surficial deposits in and near the Giles County, Virginia, seismogenic zone provided an opportunity to help alleviate this lack of attention. As part of the investigation, 20 backhoe trenches were dug on terraces of the New River in and near Giles County during June, 1981. The hope was that the trenched sediments would show features indicative of faulting or shaking that might be attributed to seismicity. In short, no such features were found. Nevertheless, the sedimentary and weathering characteristics observed during the trenching may be of interest to others planning future trenching projects, as well as to those interested in any aspect of the area's surficial geology. Therefore, descriptions and photographs of the trenches are presented below.

The Giles County seismogenic zone is centered about a line running through Pearisburg and oriented N. 43° E. (Bollinger and Wheeler, 1982, Figs. 8 and 10). The trenches described herein were in one of four general locations, ranging from about 25 km south of the seismogenic zone to the center of the zone (Fig. 1). Terraces trenched ranged from very young (2 m above modern river level) to very old (73 m above river level). On lower surfaces both terrace crests and swales were trenched in order to observe the effect of drainage upon soil properties. In addition, two trenches were dug in deposits composed mainly of New River alluvium that had been reworked and moved downslope by colluviation.

PROCEDURE

Flat or gently sloping sites were selected for all trenches, except where deliberate efforts were made to study former alluvium reworked by colluviation. All trenches reached depths of at least 3 m, and some approached 4 m. Lengths ranged from 10 m to 30 m. At least one vertical section was described for each trench, using an abbreviated version of the procedure and terminology employed by the Soil Conservation Service to describe soil profiles (Soil Survey Staff, 1975, p. 459-477). In order to avoid the use of a ladder, in many trenches where there was little lateral variation, the upper part of the section was described in a shallow part of the trench, and the lower part in a deep part.

Particular attention was given to linear features capable of showing offset (and therefore potentially capable of revealing a fault). A close watch was also kept for features resembling sand blows or sand fissures; unfortunately, no such features were seen. Most boundaries between soil horizons or sedimentary layers were diffuse and smooth, so that in the following descriptions, the nature of the boundary is mentioned only where it is other than diffuse and smooth. In many cases it was difficult to decide whether the observed layering was due to sedimentation or to pedogenesis. Therefore, the characteristics of each layer in most cases were simply described without reference to genesis. Soil colors are Munsell, and were always measured in the moist condition. Textures are given in terms of the U. S. Department of Agriculture Soil Textural Classification. Samples for laboratory grain-size analysis were collected at many profiles, and the percents sand, silt, and clay determined are included in the texture descriptions.

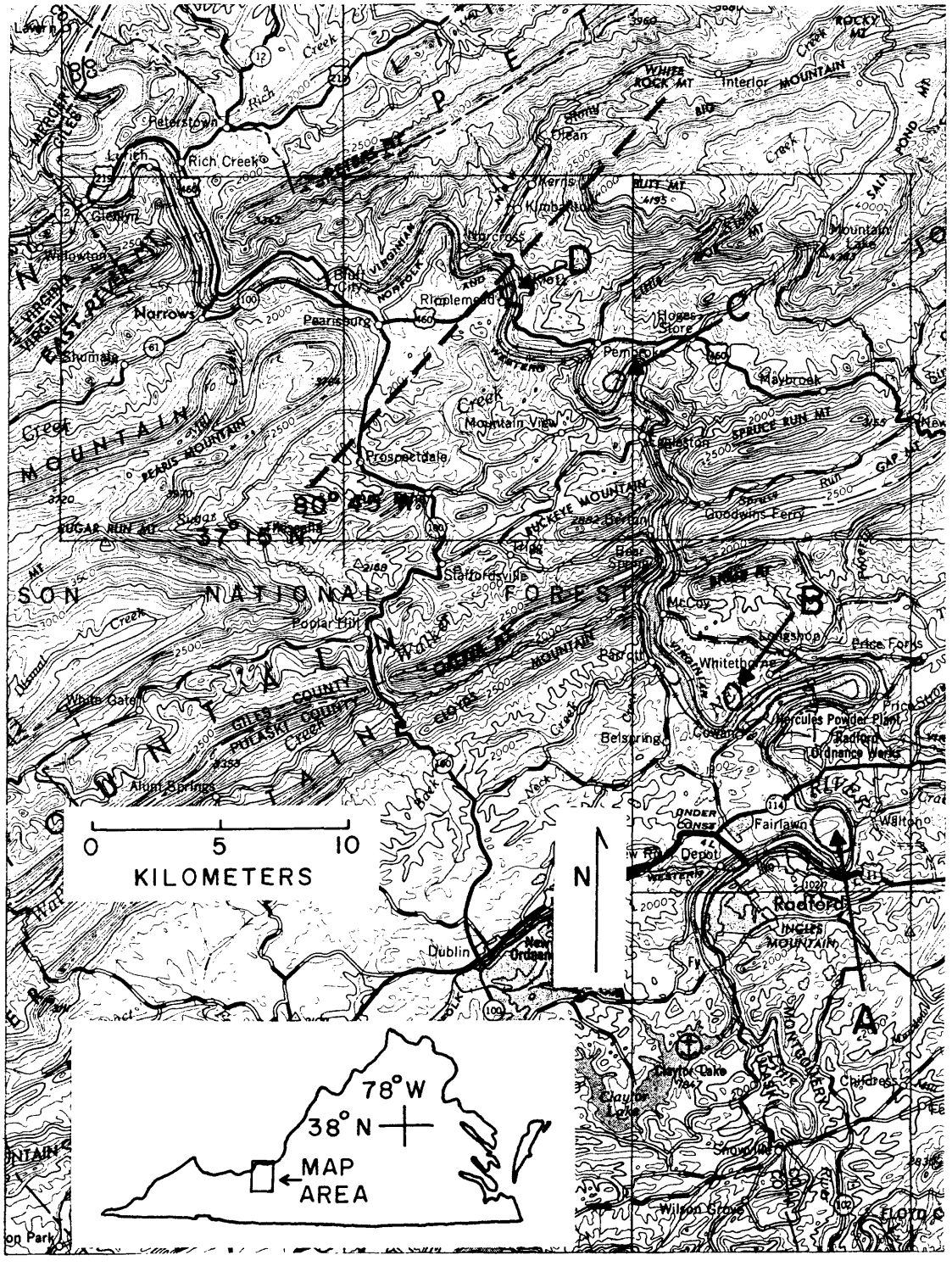

Figure 1. Index map showing general location of trenches. A. Western Electric Company Property (Trenches 1-10). B. Matthews Farm (Trenches 11-14). C. Price Farm (Trenches 15-18). D. N & W Railroad Property (Trenches 19-20). Dashed line is approximate long axis of Giles County seismogenic zone.

TRENCH DESCRIPTIONS

Western Electric Property (Radford North quadrangle, northeast of Radford)

Trench 1 East end of trench was about 27 m west of river at 37° 08' 28" N, 80° 31' 42" W, about 5 m above river level. Orientation of trench 301°, length, 30 m. West end crossed terrace crest and descended westward to terrace swale.

Profile 1 Near east end of trench, about 5 m above river level. (Fig. 2)

Depth	Description
0-18 cm	Sandy loam (64 % sand, 26 % silt, 10 % clay), 10 YR 4/3, faint root casts, rare pebbles, cobbles.
18-50 cm	Sandy loam (52 % sand, 33 % silt, 15 % clay), 8.75 YR 4/4, rare pebbles, cobbles.
50-110 cm	Loam (50 % sand, 32 % silt, 18 % clay), 8.75 YR 4/4, clear wavy boundary.
110-120 cm	Loamy sand, 7.5 YR 4/4.
120-210 cm	Loamy sand (76 % sand, 20 % silt, 4 % clay), 10 YR 4/4, with irregular layers and lenses of redder (7.5 YR 4/4) sandy loam (65 % sand, 21 % silt, 14 % clay).
210-330 cm	Loam (49 % sand, 33 % silt, 18 % clay), 10 YR 4/3. Massive.

Profile 2 Near west end of trench, in swale. Surface about 2.1 m above modern river level. (Figs. 3 and 4)

Depth	Description
0-30 cm	Sandy loam, 10 YR 3/3
30-70 cm	Loamy sand, 8.75 YR 3/4.
70-95 cm	Clay loam, 7.5 YR 4/4.
95-135 cm	Sandy loam, 10 YR 4/3.
135-155 cm	Loamy sand, 10 YR 4/2.
155-220 cm	Loamy sand, mottling (10 YR 4/1, 5 YR 3/4).
220-300 cm	Loamy sand, gleyed, 10 YR 3/1. Logs for radiocarbon dating collected at 270 cm and 300 cm (Fig. 4). Clear, wavy boundary.
300-340 cm	Sandy gravel, gleyed, 10 YR 5/1.

Figure 2. Trench 1, Profile 1.

Figure 3. Trench 1, Profile 2.

Figure 4. Trench 1, Profile 2. Close-up of gleyed sand unit containing log. Upper limit of gleying corresponds with water table.

Trench 2 East end of trench about 138 m west of river at 37° 08' 29" N, 80° 31' 45" W, about 9.1 m above river level. Roughly in line with trench 1, orientation 291°, length 25 m. East end located on terrace crest, descended westward to swale.

Profile 1 4 m from east end of trench. Surface about 9 m above river. (Fig. 5)

Depth	Description
0-34 cm	Silty clay loam, 10 YR 3/3.
34-50 cm	Silty clay loam, 8.75 YR 4/4.
50-70 cm	Clay loam (35 % sand, 37 % silt, 28 % clay).
70-100 cm	Sandy clay loam, 7.5 YR 4/4. Some pebbles and cobbles.
100-250 cm	Loam (40 % sand, 34 % silt, 26 % clay), 7.5 YR 4/6. Pebbles and small cobbles.

Comments Sediments contain more clay than in trench 1. Pebbles and cobbles also more plentiful. All clasts, including crystalline clasts, apparently unweathered. About 5 m west of profile 1 was a gravel (pebbles and cobbles) lens about 4 m wide, 80-130 cm below the surface. Swale end of trench failed to reach water table.

Trench 3 East end of trench about 200 m west of river at 37° 08' 29" N, 80° 31' 48" W, about 15.5 m above river level. Orientation of trench 287°, length, 15 m. On terrace tread.

Profile 1 Near east end of trench. Surface about 15.5 m above river. (Figs. 6 and 7).

Depth	Description
0-25 cm	A1 horizon. Clay loam (33 % sand, 35 % silt, 32 % clay), 10 YR 4/3. Rare pebbles and cobbles.
25-30 cm	Clay (31 % sand, 28 % silt, 41 % clay), 7.5 YR 4/4. Clay films on peds. Rare pebbles and cobbles.
30-50 cm	Clay loam (36 % sand, 24 % silt, 40 % clay), 7.5 YR 5/6. Iron-manganese-oxide staining (Fig. 7). Rare pebbles and cobbles.
50-170 cm	Sandy clay loam (48 % sand, 26 % silt, 26 % clay), 7.5 YR 5/6. Iron-manganese-oxide staining. Rare cobbles and pebbles.

Comments Iron-manganese-oxide films on peds and clasts, especially in upper 1 m. Crystalline clasts, including schist, still hard, although feldspars appeared more chalky than on clasts in Trench 2. Quartzite clasts unweathered, but some sandstone clasts could be broken by hand.

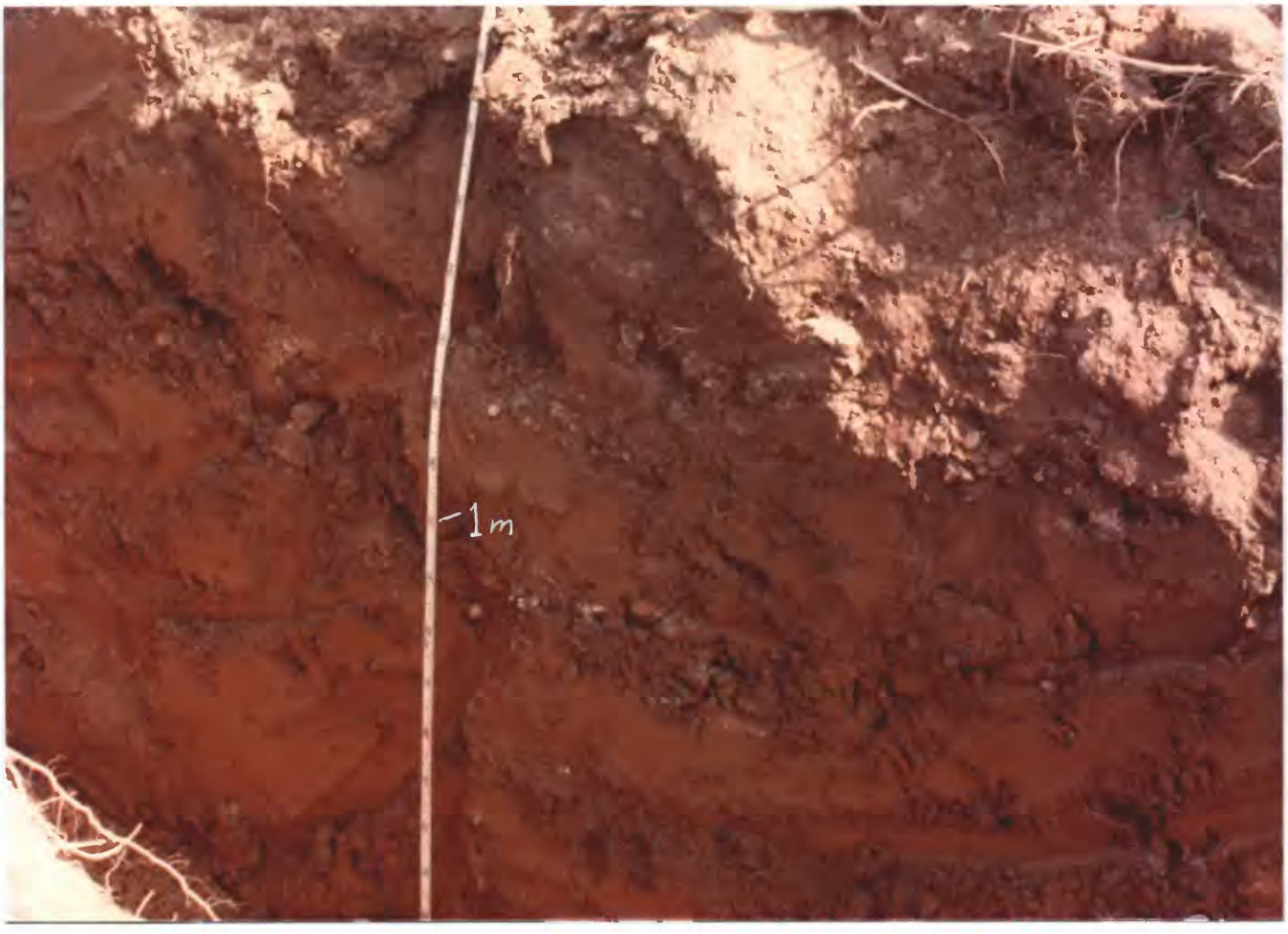

Figure 5. Trench 2, Profile 1.

Figure 6. Trench 3, Profile 1.

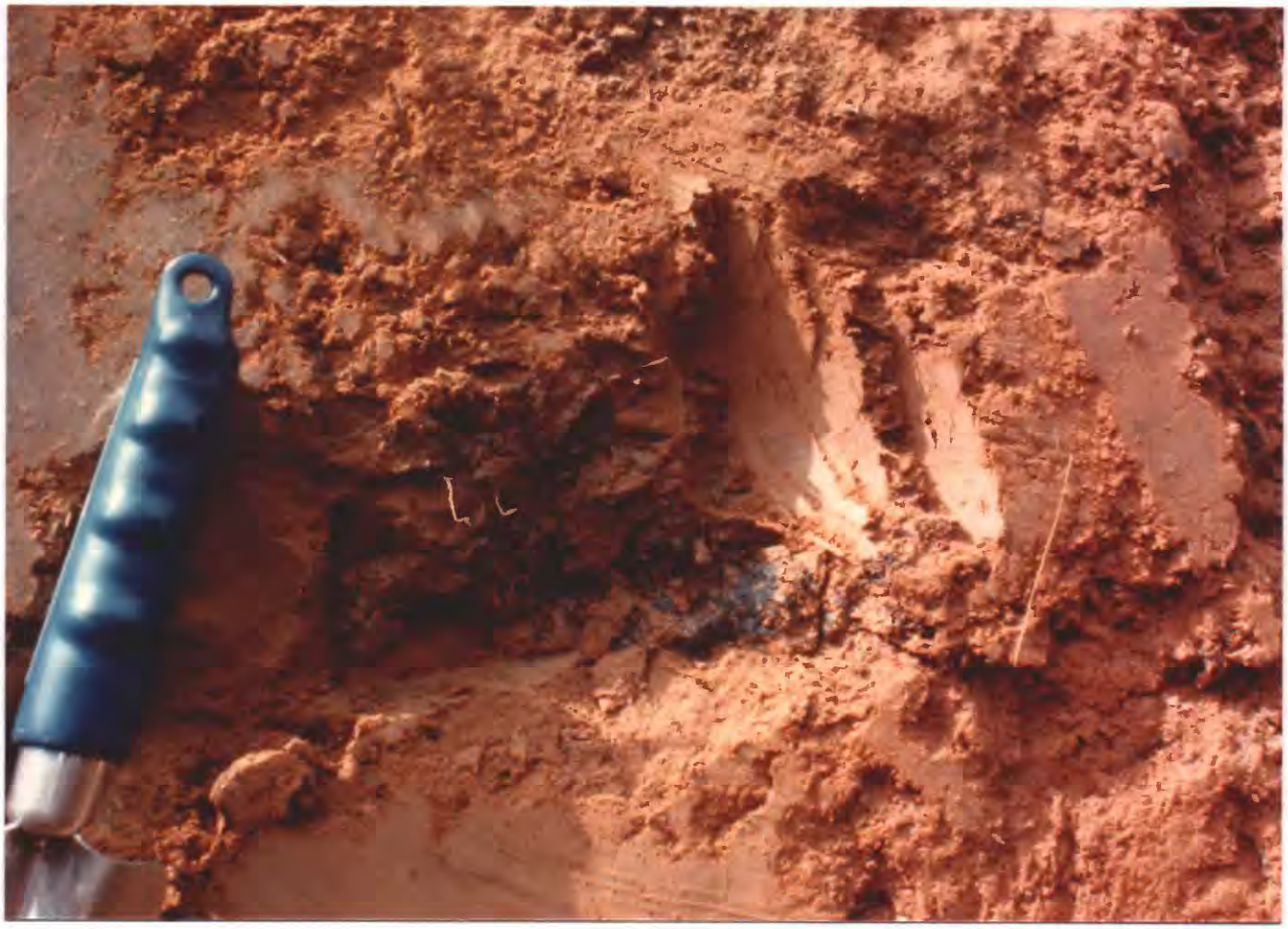

Figure 7. Trench 3, Profile 1. Close-up showing iron-manganese-oxide staining.

Profile 2 (Abbreviated)

Depth	Description
200-330 cm	Sandy clay loam (56 % sand, 23 % silt, 21 % clay), 7.5 YR 4/6.

Trench 4 East end of trench about 280 m west of river at 37° 08' 25" N, 80° 31' 51" W, about 29 m above modern river level. Orientation of trench 280°, length, 15 m. On terrace tread.

Profile 1 Near east end of trench, surface about 29 m above river. (Fig. 8).

Depth	Description
0-25 cm	Loam (41 % sand, 35 % silt, 24 % clay), 10 YR 3/3.
25-50 cm	Loam (42 % sand, 32 % silt, 26 % clay), 6.25 YR 4/6.
50-70 cm	Clay loam (37 % sand, 31 % silt, 32 % clay), 3.75 YR 4/8.
70-230 cm	Clay (27 % sand, 24 % silt, 49 % clay), 2.5 YR 4/8.

Comments Much less iron-manganese-oxide staining than in trench 3. Some sandstone clasts totally decomposed. Small purplish igneous rocks (porphyritic rhyolite ?) could be broken apart by hand, whereas larger ones were decomposed on the outside, but still hard within. Metamorphic clasts and one granitic clast still hard. Most observed clasts occurred below 300 cm. Mica also appeared to be more plentiful at lower levels.

Profile 2 (Abbreviated). Near west end of trench.

Depth	Description
260-300 cm	Clay (35 % sand, 24 % silt, 41 % clay), % YR 5/6.
300-350 cm	Sandy clay loam (49 % sand, 16 % silt, 35 % clay), 6.25 YR 5/6. Plentiful pebbles and cobbles.

Trench 5 East end of trench about 400 m west of river at 37° 08' 28" N, 80° 31' 55" W, about 40 m above modern river level. Orientation of trench 280°, length about 15 m. About 30 m, 050° from power lines. Upper soil layers were bulldozed off during World War II.

Profile 1 Near east end of trench. Surface about 40 m above river. (Figs. 9 and 10).

Depth	Description
0-15 cm	Sandy clay loam, 5 YR 5/6. Boundary clear, smooth.

Figure 8. Trench 4, Profile 1.

Figure 9. Trench 5, Profile 1.

Figure 10. Trench 5, Profile 1. Close-up showing decomposed igneous clast.

15-34 cm — Clay (33 % sand, 17 % silt, 50 % clay), 2.5 YR 4/6. Boundary clear, smooth.

34-55 cm — Sandy clay loam (48 % sand, 22 % silt, 30 % clay), 7.5 YR 5/6, with common coarse red mottles (2.5 YR 4/6). Many pebbles and cobbles. Boundary abrupt, smooth.

55-71 cm — Sandy loam (58 % sand, 23 % silt, 19 % clay), 5YR 5/6. Many small pebbles. Boundary clear, smooth.

71-98 cm — Clay (25 % sand, 33 % silt, 42 % clay), 10 YR 5/6. Common red mottles (2.5 YR 5/8). Boundary diffuse, smooth.

98-104 cm — Sandy clay loam. Irregular reddish layer. Gradual, wavy boundary. 5 YR 5/8.

104-122 cm — Sandy loam, 6.25 YR 5/6. Some iron-manganese-oxide staining . Micaceous.

122-125 cm — Sandy clay loam. Gray (10 YR 4/2) lens, pinches out 0.5 m to west, 5.0 m to east. Some mixed red and yellow material. To east, thickness reaches 6 cm. Boundary abrupt, smooth.

125-160 cm — Many medium mottles, clay loam (2.5 YR 4/8) and sandy loam (10 YR 5/6). Boundary diffuse, smooth.

160-173 cm — Silty clay loam, 2.5 YR 4/8. Boundary clear, smooth.

173-184 cm — Silty clay loam, 10 YR 6/6. Has red mottles. Lenses out about 7 m to west. Boundary clear, smooth.

184-220+ cm — Sandy loam, 5YR 5/8 with darker red mottling (2.5 YR 5/8).

Profile 2 (Abbreviated) Near west end of trench. (Fig. 11).

Depth	Description
260-300 cm	Sandy clay, 2.5 YR 4/6. Some cobbles. Boundary abrupt, smooth.
300-320+ cm	Sandy clay loam, 10 YR 5/2. Grey unit (Fig. 11).

Comments This trench showed the most intricate layering, and the greatest variety of texture and color, of any dug. Igneous clasts observed were completely decomposed (Fig. 10).

Trench 6 East end of trench located about 470 m west of river at 37° 08' 31" N, 80° 31' 57" W, about 40 m above river level. Orientation of trench 302°, length 15 m. On tread of same terrace as Trench 5, about 75 m NNE of Trench 5. Unlike Trench 5, topsoil in place. Located along edge of field.

Figure 11. Trench 5, Profile 2, showing abrupt contact between red sandy clay unit at 260-300 cm and grey sandy loam unit at 300-320+ cm.

Profile 1 Near east end of trench. (Figs. 12 and 13).

Depth	Description
0-40 cm	Plow layer. Sandy loam, 10 YR 4/3. Inclusions of red soil.
40-65 cm	Clay loam (44 % sand, 30 % silt, 26 % clay), 7.5 YR 5/6.
65-85 cm	Clay (30 % sand, 21 % silt, 49 % clay), 5 YR 5/8. Faint mottling. Thick clay skins on peds.
85-210 cm	Clay (34 % sand, 16 % silt, 50 % clay), 2.5 YR 4/7. Yellow mottles (10 YR 5/6). Thick clay skins on peds.
210-222 cm	Hard iron-manganese-oxide-rich layer (Fig. 13).
222-230+ cm	Sandy clay loam. Red and yellow mottling.

Comments Little mica compared to previous trenches.

Profile 2 (Abbreviated) Near west end of trench.

Depth	Description
140-280 cm	Clay loam (39 % sand, 25 % silt, 36 % clay), mottling (7.5 YR 5/8, 2.5 YR 4/6). Relatively micaceous.
280-283 cm	Iron-manganese-oxide layer. Abrupt, wavy boundary, goes up to west, down to east.
283-340 cm	Sandy clay loam, 7.5 YR 5/8. Micaceous.

Trench 7 East end of trench 440 m west of river at 37° 08' 58" N, 80° 32' 02" W, about 67 m above modern river level. Orientation of trench 260°, length, 15 m. Located on broad hilltop.

Profile 1 5 m from west end of trench. Surface about 67 m above river level. (Figs. 14 and 15).

Depth	Description
0-18 cm	A1 horizon. Sandy loam (61 % sand, 21 % silt, 18 % clay), 10 YR 4/3.
18-84 cm	Clay (31 % sand, 26 % silt, 43 % clay), 6.25 YR 5/8. Some yellow mottling, root casts. Some quartz pebbles and cobbles. Boundary abrupt, irregular, and marked by iron-manganese-oxide layer.
84-90 cm	Iron-manganese-oxide layer, varies laterally from 1 to 6 cm thick. Contains iron-manganese-oxide nodules. Boundary abrupt, irregular. (Fig. 15).

Figure 12. Trench 6, Profile 1.

Figure 13. Trench 6, Profile 1, showing iron-manganese-oxide layer at 220 cm.

Figure 14. Trench 7, Profile 1.

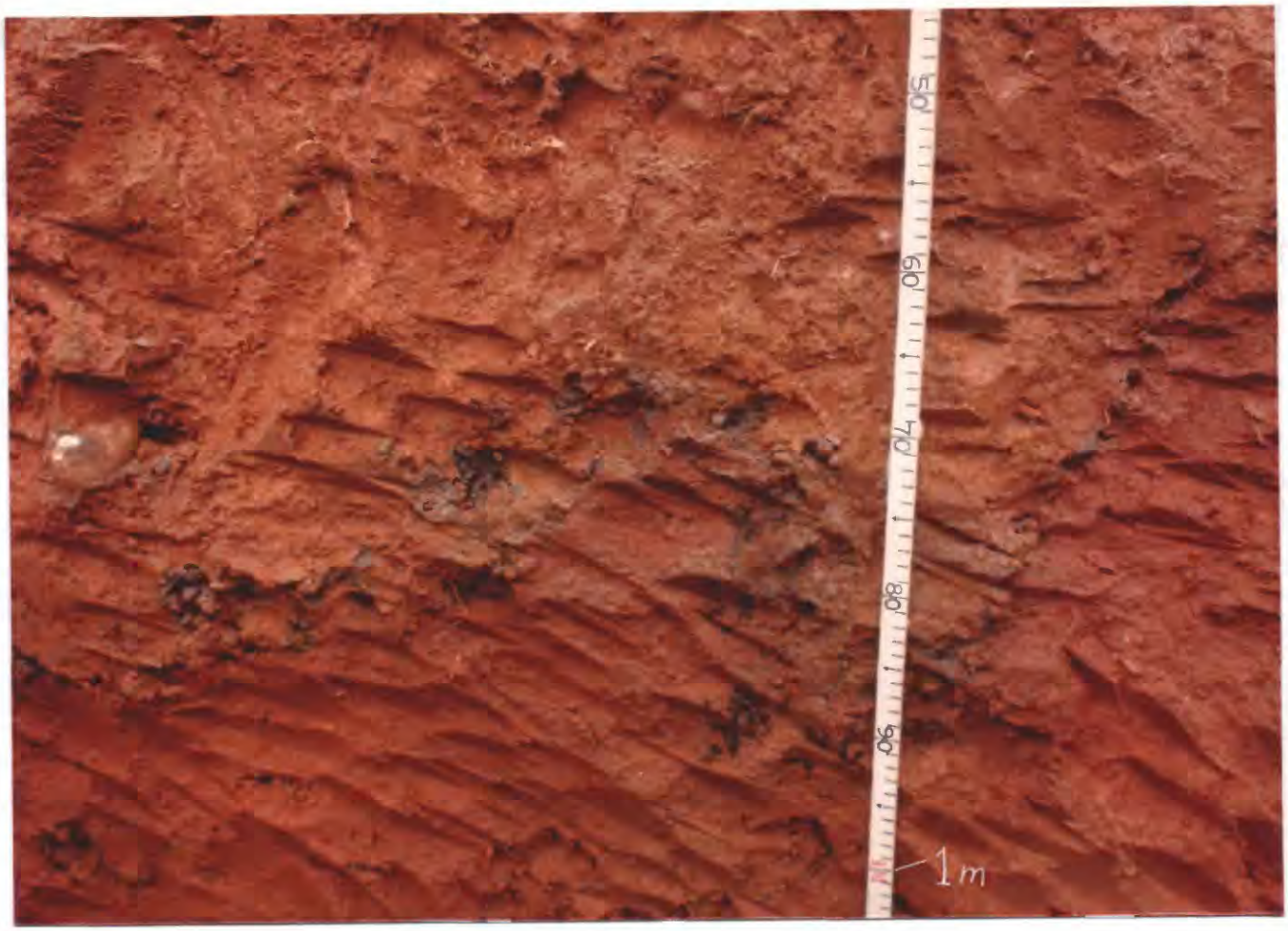

Figure 15. Trench 7, Profile 1, close-up of iron-manganese-oxide layer.

90-200 cm	Clay (42 % sand, 10 % silt, 48 % clay). Color varies laterally from 3.75 YR 4/8 to 10 R 4/8, with latter material having a slightly finer texture. Streaks and nodules of iron-manganese oxide. Sandstone and igneous clasts are completely weathered through. Some quartz cobbles and pebbles.

Profile 2 (Abbreviated) 7 m east of profile 1. (Fig. 16).

Depth	Description
180-350 cm	Sandy clay, 3.75 YR 4/8 with faint yellow mottling. Particle-size samples at 150 cm (47 % sand, 11 % silt, 42 % clay) and at 300 cm (48 % sand, 8 % silt, 44 % clay). Some cobbles and pebbles. Prominent iron-manganese-oxide layer (Fig. 16).

Comment Mica content lower than in most trenches at lower elevations.

Trench 8 North end of trench about 770 m west of river at 37° 09' 00" N, 80° 32' 16" W, about 73 m above modern river level. Orientation of trench 185°, length, 10 m.

Profile 1 (Fig. 17).

Depth	Description
0-25 cm	Loam (48 % sand, 34 % silt, 18 % clay), 10 YR 4/3.
25-40 cm	Loam (41 % sand, 33 % silt, 26 % clay), 7.5 YR 5/6.
40-58 cm	Clay (26 % sand, 27 % silt, 47 % clay), 5 YR 5/6.
58-104 cm	Clay loam (23 % sand, 40 % silt, 37 % clay), red (2.5 YR 4/8) with yellow (10 YR 5/6) mottles.
104-138 cm	Clay loam (26 % sand, 38 % silt, 36 % clay), red (2.5 YR 4/6) with rare yellow mottles.
138-210 cm	Clay (32 % sand, 24 % silt, 44 % clay), red (2.5 YR 4/8) with yellow (10YR 6/8) mottles.

Profile 2 (Abbreviated)

Depth	Description
138-255 cm	Clay. Red (2.5 YR 4/8) with yellow (10 YR 6/8) mottles. Micaceous. (Same unit as bottom unit of profile 1).
255-340 cm	Clay loam. Orange (6.25 YR 5/8) with faint yellow mottling. Micaceous.

Comment Mica at this location confined chiefly to lower two units above.

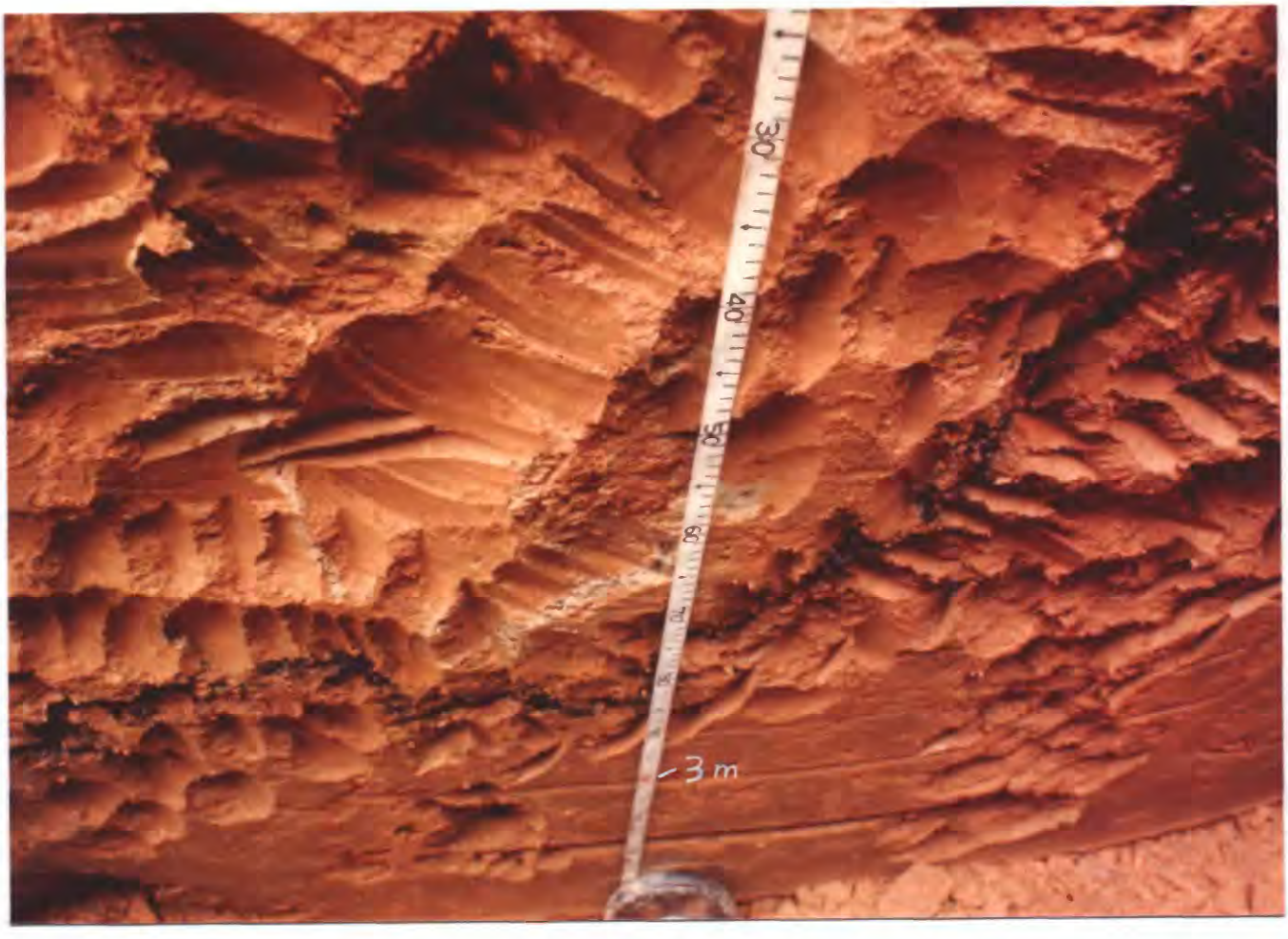

Figure 16. Trench 7, Profile 2, close-up of iron-manganese-oxide layer.

Figure 17. Trench 8, Profile 1.

Trench 9 North end of trench 240 m south of river at 37° 09' 18" N, 80° 32' 10" W, about 7 m above river level. Orientation of trench 360°, length about 25 m. South end on toe of alluvial fan descending onto terrace from uplands to south, north end in terrace slough. Soil very sandy at end of trench on fan, clayey at end of trench in slough. (Figs. 18-20).

Profile 1 2 m from north end, in terrace slough. (Fig. 18).

Depth	Description
0-75 cm	Organic-rich sandy clay loam (52 % sand, 20 % silt, 28 % clay), 10 YR 3/2.
75-105 cm	Transitional layer. Sandy clay.
105-163 cm	Clay (23 % sand, 36 % silt, 41 % clay), red (5 YR 5/6) and yellow (10 YR 6/4) mottling.
163-166 cm	Iron-manganese-oxide stained sandy unit, micaceous. Variegated colors.
166-175 cm	Clay (18 % sand, 38 % silt, 44 % clay), yellow (10 YR 6/4) with red mottling.
175-177 cm	Iron-manganese-oxide stained sandy unit.
177-250 cm	Sandy clay loam (66 % sand, 10 % silt, 24 % clay), 6.25 YR 5/6.
250-300+ cm	Loamy sand, 6.25 YR 5/6.

Comment Immediately to north is gravel lens with rounded pebbles and cobbles.

Profile 2 5 m from north end of trench. Just below toe of fan. (Fig. 19).

Depth	Description
0-55 cm	Sandy loam, 10 YR 3/1.
55-100 cm	Sandy loam (67 % sand, 19 % silt, 14 % clay), 10 YR 3/1.
100-120 cm	Sandy loam (65 % sand, 19 % silt, 16 % clay), 8.75 YR 4/4.
120-145 cm	Sandy loam (66 % sand, 19 % silt, 15 % clay), 7.5 YR 4/4.
145-210+ cm	Sandy clay loam (58 % sand, 20 % silt, 22 % clay), red (7.5 YR 5/6) and yellow (10 YR 7/4) mottling.

Comment No clasts observed.

Profile 3 Toe of fan. 15 m from north end of trench.

Depth	Description
0-30 cm	Loamy sand, 10 YR 4/2.

Figure 18. Trench 9, Profile 1.

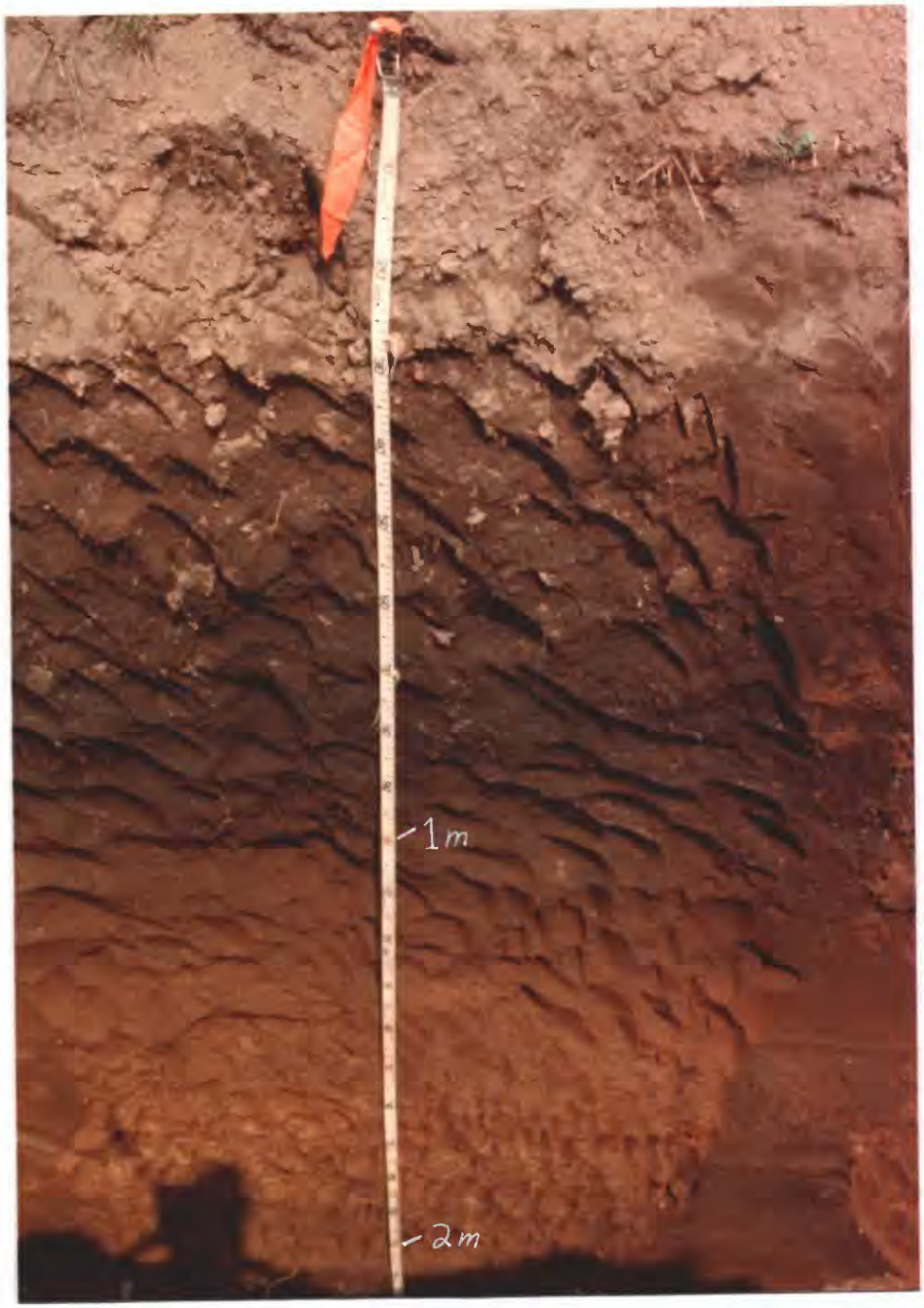

Figure 19. Trench 9, Profile 2.

30-65 cm	Loamy sand (82 % sand, 12 % silt, 6 % clay), 7.5 YR 4/4.
65-130 cm	Sand (90 % sand, 4 % silt, 6 % clay), 7.5 YR 4/4.
130-175 cm	Sand (90 % sand, 2 % silt, 8 % clay), 7.5 YR 4/4.
175-195 cm	Sand (90 % sand, 2 % silt, 8 % clay), 6.25 YR 4/6.
195-220+ cm	Loamy sand, 7.5 YR 4/6.

Comment Almost no clasts.

Trench 10 North end of trench about 340 m south of river at 37° 09' 15" N, 80° 32' 10" W, about 10.5 m above river level. Orientation of trench 360°, in line with trench 9. Length about 15 m. Located within about 30 m of head of alluvial fan (Fig. 20), oriented down slope of fan. Slope angle about 5°.

Profile 1 (Figs. 21 and 22).

Depth	Description
0-50 cm	Sandy clay loam (51 % sand, 27 % silt, 22 % clay), 10 YR 4/2. Many pebbles and granules, some angular (angularity suggests fan deposits).
50-60 cm	Sandy clay loam (45 % sand, 25 % silt, 30 % clay), 10 YR 4/2.
60-135 cm	Clay (33 % sand, 17 % silt, 50 % clay), 7.5 YR 5/6. Faint mottling.
135-158 cm	Clay loam (42 % sand, 20 % silt, 38 % clay), 10 YR 5/6 with mottling.
158-200 cm	Clay loam (44 % sand, 17 % silt, 39 % clay), variegated mottled layer, with red (3.75 YR 4/8) the dominant color. Clear, smooth boundary.
200-350 cm	Sandy gravel (matrix is sandy loam - 80 % sand, 7 % silt, 13 % clay) with pebbles and cobbles. 5 YR 5/6. Contains angular clasts.
350+ cm	Sand layer below gravel.

Comments The above profile is seen throughout the trench. That is, the upper layers contain much clay and relatively few clasts, but about 200 cm down is found a reddish gravel-rich layer containing some angular clasts. The contact at 200 cm slopes in a direction parallel to that of the fan slope.

Figure 20. View of Trench 10, located on alluvial fan descending from upland onto terrace, from vicinity of Trench 9. Slope angle near head of fan about 5^{o}.

Figure 21. Trench 10, Profile 1 (upper part).

Figure 22. Trench 10, Profile 2 (lower part). Note contact between clay loam unit above and gravel unit below at about 200 cm. (Tape in photo does not correspond to position of tape used for profile measurements).

Matthews' Farm Property (Radford North quadrangle, about 1 km southwest of Whitethorn)

Trench 11 Southeast end of trench located about 640 m northwest of river at 37° 11' 47" N, 80° 34' 43" W, about 21 m above river level. Orientation of trench 137°, length, 10 m. About 60 m southeast of barn. On tread of terrace (Fig. 23).

Profile 1 Sand overlying gravel overlying weathered shale. (Figs. 23-26).

Depth	Description
0-20 cm	Loam (44 % sand, 43 % silt, 13 % clay), 10 YR 3/3. Numerous cobbles and pebbles.
20-58 cm	Loam (36 % sand, 41 % silt, 23 % clay), 10 YR 6/4. Numerous cobbles and pebbles.
58-140 cm	Gravel with clasts ranging in size from granules to small boulders. Some sandstone clasts weathered, but most clasts relatively unweathered. Matrix is clay loam (34 % sand, 26 % silt, 40 % clay), with variegated colors (7.5 YR 5/6, 7.5 YR 5/8, 10 YR 5/3). Abrupt, smooth boundary. Contact with underlying shale dips to northwest at about 2°. A long-axis fabric was measured on clasts in this layer, and showed a weak, though significant, preferred orientation oblique to the modern river trend.
140-350+ cm	Weathered shale, variegated colors (10 YR 5/8, 2.5 YR 4/8, 7.5 YR 5/8). Strike and dip of shale beds, 110°, 14° S.

Comments This is an excellent example of a strath terrace, as despite the prominent form of the terrace (Fig. 23), the alluvial mantle is less than 2 m thick. The top of the gravel layer increases in depth to the northwest. Of interest is the fact that relatively fresh gravel overlies weathered bedrock. Whether this occurs because the porous alluvium weathers more slowly than the shale bedrock, or because the New River flowed over weathered bedrock at the time it cut this strath, is unknown, although the former explanation seems more probable.

Trench 12 South end of trench about 15 m northwest of river at 37° 11' 35" N, 80° 34' 22" W, about 3 m above river level. Orientation of trench 348°, length about 20 m. End near river in swale, end away from river on tread of next higher terrace level. (Fig. 27).

Profile 1 Located near south end of trench (toward river) in swale. Surface about 2 m above river level. (Figs. 27 and 28).

Depth	Description
0-60 cm	Silty clay loam (44 % sand, 43 % silt, 13 % clay), 10 YR 4/3.
60-70 cm	Silty clay loam, 10 YR 3/4.

Figure 23. View looking southwest of part of Matthews farm. Prominent terrace at right is location of Trench 11; broad terrace in foreground is location of Trench 14. New River is off picture to left.

Figure 24. Trench 11. Tape is just below contact of gravel unit with underlying weathered shale.

Figure 25. Trench 11, near Profile 1. Contact of gravel unit with underlying weathered shale is at about 140 cm.

Figure 26. Trench 11, near Profile 1. Close-up of contact of gravel unit with underlying weathered shale.

Figure 27. View of Trench 12, looking south to river.

Figure 28. Trench 12, Profile 1. Note gleyed zone and log near base of profile.

70-95 cm	Silty clay loam. Colors mottled (7.5 YR 4/6, 10 YR 4/4).
95-180 cm	Clay loam (30 % sand, 38 % silt, 32 % clay), 7.5 YR 4/4.
180-183 cm	Loamy sand, 7.5 YR 3/2.
183-200 cm	Silty clay, 7.5 YR 4/4.
200-245 cm	Alternating layers and lenses of silty and sandy sediments (finer layer is clay loam: 23 % sand, 43 % silt, 34 % clay). Variegated colors (2.5 Y 4/2, 10 YR 3/3, 10 YR 3/3, 8.75 YR 4/4. Log for radiocarbon dating obtained at 235 cm (Fig. 28).
245-283 cm	Sandy loam (71 % sand, 21 % silt, 8 % clay), 10 YR 4/1 (gleyed).
283-295 cm	Pebble-size gravel with loamy sand matrix. 10 YR 4/1 (gleyed).
295+ cm	Unweathered siltstone bedrock.

Comment A second wood sample was obtained from about 250 cm at another location in the trench.

Profile 2 Located near north end of trench, on tread of next higher terrace. 15 m north of profile 1. 3.7 m above river level. (Fig. 29).

Depth	Description
0-45 cm	Silty clay loam, 10 YR 3/4.
45-85 cm	Silty clay loam, 7.5 YR 4/6.
85-110 cm	Silty clay loam, 10 YR 3/4.
110-140 cm	Silt loam, 10 YR 3/4.
140-178 cm	Silty clay loam, 7.5 YR 4/4.
178-230+ cm	Silty clay loam, 10 YR 3/3.

Trench 13 South end of trench located about 83 m from river at 37° 11' 37" N, 80° 34' 23" W, about 2.7 m above river level. About 68 m north of profile 1 of Trench 2. Orientation of trench 346°, length, 10 m. In swale on north side of crest of second terrace from river.

Profile 1 South end of trench, in swale. (Figs. 30 and 31).

Depth	Description
0-30 cm	Silt loam, 7.5 YR 4/4
30-42 cm	Loam (33 % sand, 44 % silt, 23 % clay), 7.5 YR 3/4.
42-60 cm	Sandy loam, 10 YR 3/2.

Figure 29. Trench 12, Profile 2.

Figure 30. Trench 13, Profile 1. Note gleyed zone near base from which log was taken.

Figure 31. Trench 13, after collapse.

60-85 cm — Loam (20 % sand, 51 % silt, 29 % clay), 10 YR 3/2.

85-310 cm — Silty clay loam (sample at 190 cm - 13 % sand, 50 % silt, 37 % clay) to clay loam (sample at 220 cm - 25 % sand, 44 % silt, 31 % clay), 10 YR 4/3.

310-330 cm — Silty clay loam, 10 YR 5/3.

330-390 cm — Sandy loam (75 % sand, 17 % silt, 8 % clay), 10 YR 3/1 (gleyed). Logs for radiocarbon dating obtained from about 370 cm.

390+ cm — Unweathered siltstone bedrock.

Comments This profile had the only good example of a buried A1 horizon (42-85 cm) seen during the trenching project (Fig. 30). This trench was very unstable, collapsing almost completely shortly after work was completed (Fig. 31). Lower units contained some gravel.

Trench 14 Southeast end of trench about 68 m northwest of railroad tracks (about 250 m northwest of river) and about 40 m northeast of road leading to barn, at 37° 11' 41" N, 80° 34' 37" W, about 12 m above river level. Orientation of trench 320°, length, 20 m. On tread of third terrace up from river (Fig. 23).

Profile 1 (Fig. 32).

Depth	Description
0-40 cm	Sandy clay loam, 10 YR 3/3.
40-195 cm	Clay loam (sample at 70 cm - 41 % sand, 29 % silt, 30 % clay) to sandy clay loam (sample at 160 cm - 55 % sand, 20 % silt, 25 % clay), 7.5 YR 4/6. Some pebbles and cobbles.
195-210 cm	Gravel layer with sandy loam matrix. Matrix color 7.5 YR 5/6. Layer extends at least 5 m.
210-255 cm	Sandy clay loam (67 % sand, 13 % silt, 20 % clay), 7.5 YR 5/6. Rare pebbles and cobbles.
255-257 cm	Thin gravel layer with pebbles.
257-330+ cm	Loamy sand, 7.5 YR 4/6. Rare pebbles and cobbles.

J. A. Price Farm Property (Pearisburg quadrangle, about 2 km south of Pembroke)

Trench 15 Southeast end about 40 m from old house at 37° 18' 08" N, 80° 37' 59" W, about 15 m above river level. Orientation of trench about 305°, length, 15 m. On terrace tread. About 270 m northwest of river.

Figure 32. Trench 14, Profile 1.

Profile 1 Near southeast end of trench. (Fig. 33).

Depth	Description
0-20 cm	Sandy clay loam, 10 YR 3/3.
20-50 cm	Clay loam (36 % sand, 35 % silt, 29 % clay), 7.5 YR 5/6. Some iron-manganese-oxide films.
50-75 cm	Sandy clay loam, 8.75 YR 5/8. Some iron-manganese-oxide films.
75-95 cm	Clay loam (30 % sand, 33 % silt, 37 % clay), 10 YR 5/8. Iron-manganese-oxide films prominent.
95-190 cm	Clay loam (29 % sand, 33 % silt, 38 % clay), 10 YR 5/6. Prominent iron-manganese-oxide films. Thin pebble and granule layer at 160 cm.
190-340 cm	Sandy clay loam (56 % sand, 24 % silt, 20 % clay), 7.5 YR 5/6. Iron-manganese-oxide staining less prominent than in overlying units.

Trench 16 On lowest wide terrace. Northwest end 100 m from river at 37° 18' 03" N, 80° 37' 57" W, about 6 m above river level. Orientation 305°, length, 10 m. Located in swale.

Profile 1 (Figs. 34 and 35)

Depth	Description
0-40 cm	Sandy loam, 10 YR 4/2.
40-110 cm	Sandy loam (58 % sand, 27 % silt, 15 % clay), 10 YR 3/3.
110-155 cm	Sandy clay loam (49 % sand, 27 % silt, 24 % clay), 10 YR 4/3.
155-175 cm	Sandy clay loam (52 % sand, 25 % silt, 23 % clay), 10 YR 4/4. Few clasts in this and higher units.
175-315 cm	Boulder-gravel unit, with boulders as large as 600 mm by 500 mm by 300 mm. Matrix of sandy loam (68 % sand, 13 % silt, 19 % clay), matrix color 8.75 YR 4/6. Figure 35 shows contact between this unit and overlying sandy units.
315-350 cm	Loam (28 % sand, 47 % silt, 25 % clay) with gravel, 2.5 Y 7/6.
350+ cm	Sandstone bedrock.

Comments Boundaries all gradual and wavy. Two test pits were dug on the same terrace as Trench 16. The first was located 55 m ESE from Trench 16, and hit boulder gravel at 280 cm. The second was located about 320 m downstream from Trench 16, about 100 m from river. Boulder gravel was encountered at 150 cm, and bedrock at 190 cm.

Figure 33. Trench 15, Profile 1.

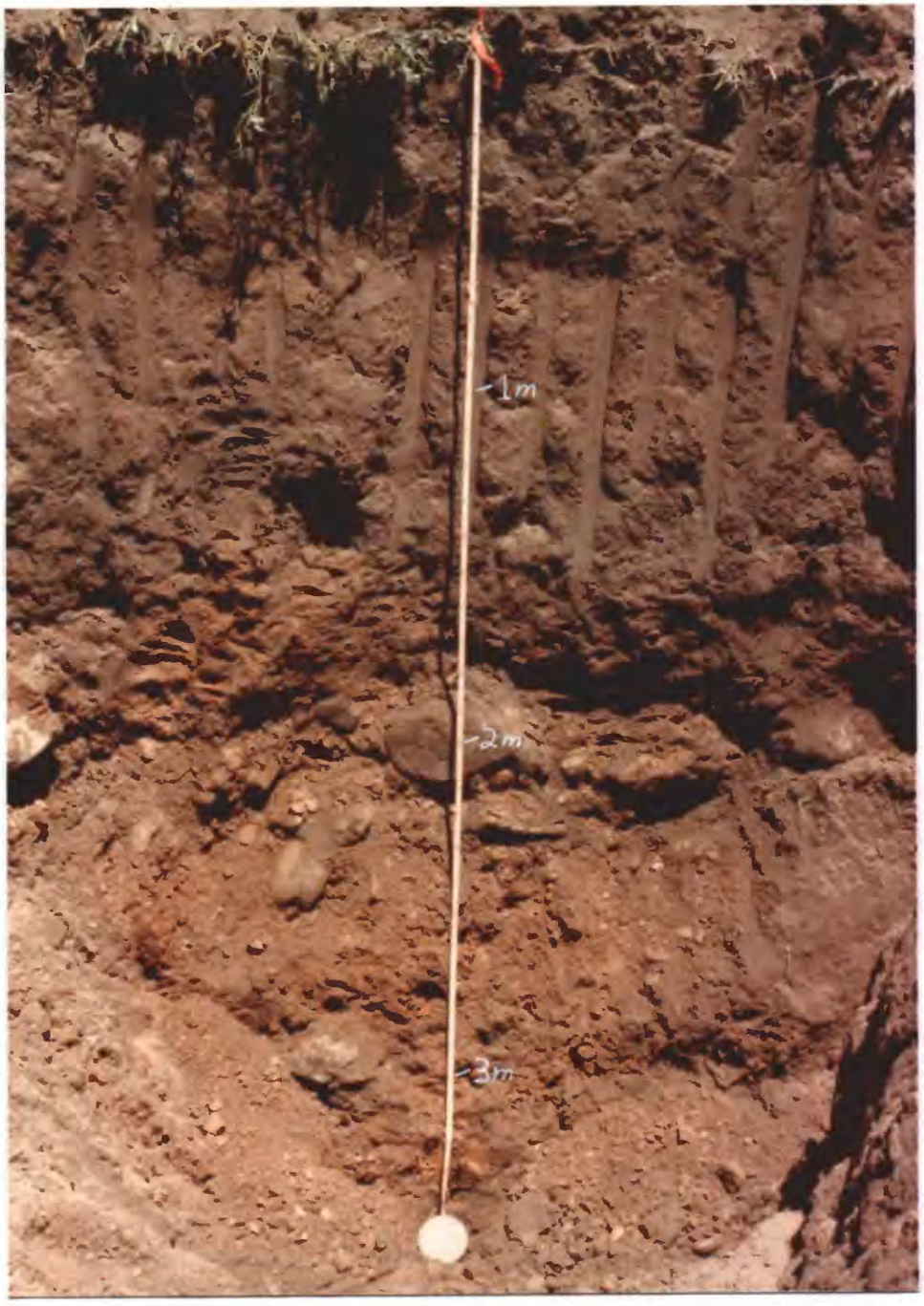

Figure 34. Trench 16, Profile 1.

Figure 35. Trench 16, Profile 1. Close-up showing contact of sandy unit with underlying boulder-gravel unit at about 175 cm.

Trench 17 Southeast end of trench about 480 m northwest of river at 37° 18' 12" N, 80° 38' 09" W, about 60 m above river level. Orientation of trench 305°, length, 15 m. Located on nearly level top of spur.

Profile 1 (Figs. 36 and 37)

Depth	Description
0-20 cm	Sandy loam, 10 YR 4/2. Some pebbles, cobbles.
20-35 cm	Loam (47 % sand, 37 % silt, 16 % clay), 10 YR 5/4.
35-65 cm	Clay loam (44 % sand, 27 % silt, 29 % clay), 10 YR 5/8. Many pebbles, cobbles. Some decomposed sandstone clasts.
65-98 cm	Clay (31 % sand, 24 % silt, 45 % clay), mottled color (7.5 YR 5/8, 7.5 YR 6/8). Pebbles throughout unit. Boundary clear, smooth, dipping to NW.
98-134 cm	Gravel layer of pebbles and small cobbles. Matrix is clay loam (29 % sand, 36 % silt, 35 % clay), variegated colors (7.5 YR 6/8, 7.5 YR 5/8, 5 YR 5/8). Decomposed sandstone and crystalline clasts. Boundary abrupt, wavy, dipping 16° to NW. Unit pinches out 3.5 m to NW, rises to surface 2.5 m to SE. Near southeast end, dip of boundary steepens to 30°.
134-175 cm	Sandy clay loam (60 % sand, 12 % silt, 28 % clay), color mottled (7.5 YR 6/8, 5 YR 5/8). Iron-manganese-oxide stains and layers (Fig. 37). Texture varies laterally. Almost no clasts.
175-178 cm	Sandy loam, 7.5 YR 5/8. Boundary abrupt, irregular.
178-190 cm	Loamy sand, 7.5 YR 6/8. Boundary abrupt, wavy, dips 20° to NW.
190-220 cm	Gravel unit, mainly pebbles and small cobbles. Sandstone and crystalline clasts generally decomposed. Sandy loam matrix, 8.75 YR 6/8. Iron-manganese-oxide stains and layers. Boundary abrupt, wavy, dips steeply to NW. Unit continues about 3 m NW, 5 m SE. Relatively little mica compared to lower terraces.
220-250+ cm	Sandy loam, 7.5 YR 7/8.

Profile 1B (Abbreviated) About 3 m NW of profile 1. (Fig. 38).

Depth	Description
230-350 cm	Sandy loam, mottled (7.5 YR 5/8, 2.5 YR 7/4). Rare pebbles, cobbles.

Profile 2 3.7 m southeast of profile 1. (Fig. 39).

Depth	Description
0-15 cm	Sandy loam, 10 YR 3/3.

Figure 36. Trench 17, Profile 1.

Figure 37. Trench 17, near Profile 1. Close-up of iron-manganese-oxide staining.

Figure 38. Trench 17, Profile 1B.

Figure 39. Trench 17, Profile 2.

15-40 cm	Sandy clay loam with some cobbles, pebbles. 10 YR 5/4.
40-65 cm	Gravel layer, pebbles and cobbles. Sandy clay loam matrix, 10 YR 6/6.
65-110 cm	Sandy clay loam, mottled color (10 YR 5/8, 5 YR 5/8). Rare pebbles, small cobbles. Boundary abrupt, wavy, dips 18° to NW.
110-142 cm	Gravel layer with sandy clay matrix, matrix color 5 YR 5/8. Corresponds to lower gravel unit, profile 1. Boundary abrupt, wavy, dips to NW, then becomes horizontal.
142-165 cm	Loamy sand, 7.5 YR 6/8. Rare pebbles. Boundary abrupt, wavy.
165-185 cm	Gravel layer with sandy clay loam matrix, matrix color 6.25 YR 5/8. Boundary abrupt, wavy, dips NW.
185-230+ cm	Sandy loam, 7.5 YR 5/8. Rare clasts. Abundant iron-manganese oxide.

Trench 18 South end of trench about 420 m NW of river at 37° 18' 15" N, 80° 38' 05" W, about 21 m above river level. Orientation of trench 172°, length about 15 m. Trench oriented down slope of hillside, near toe of slope. Slope angle 11°. Soil material probably consists of former alluvium that has been moved downhill by colluviation.

Profile 1

Depth	Description
0-30 cm	Loam (38 % sand, 43 % silt, 19 % clay), 7.5 YR 3/2.
30-60 cm	Clay loam (35 % sand, 36 % silt, 29 % clay), 7.5 YR 3/2.
60-110 cm	Clay loam (34 % sand, 31 % silt, 35 % clay), 3.75 YR 4/6. Much iron-manganese oxide present as films and fragments (latter probably eroded from preexisting films and layers uphill).
110-230+ cm	Clay (35 % sand, 19 % silt, 46 % clay), mottled color (10 YR 5/8, 10 R 4/6).

Comments Note color values low to a depth of 60 cm, indicating a high organic content to that depth. This thick organic-rich layer probably is a consequence of the location of the profile near toe slope. Pebbles and small cobbles scattered throughout profile.

N & W Railroad Property (Pearisburg quadrangle, on west side of New River, just north of old Highway 460 bridge)

Trench 19 Located about 180 m north of old 460 bridge (as measured just below railroad track embankment). East end about 30 m west of river, at

37° 20' 09" N, 80° 40' 38" W, about 5.9 m above river level. Orientation of trench 100°, length, 20 m. On surface of main low terrace.

Profile 1 About 5 m from east end of trench. (Figs. 40 and 41).

Depth	Description
0-70 cm	Sandy loam (64 % sand, 23 % silt, 13 % clay), 10 YR 4/4.
70-90 cm	Heavy sandy loam, 10 YR 4/4.
90-140 cm	Sandy clay loam (52 % sand, 27 % silt, 21 % clay), 10 YR 4/4.
140-260 cm	Loam (46 % sand, 32 % silt, 22 % sand), 10 YR 4/4.
260-350+ cm	Sandy loam (62 % sand, 22 % silt, 16 % clay), 10 YR 4/6.

Profile 2 About 5 m from west end of trench.

Depth	Description
0-30 cm	Loamy sand, 10 YR 3/2.
30-55 cm	Sandy loam, 10 YR 3/3.
55-190 cm	Sandy loam, 10 YR 4/3.
190-240+ cm	Sandy loam, 7.5 YR 4/4.

Trench 20 On same terrace about 150 m north of Trench 1, east end located at 37° 20' 14" N, 80° 40' 38" W, about 6 m above river level. Orientation of trench 100°, length, 20 m.

Profile 1 About 4 m from east end of trench. (Fig. 42).

Depth	Description
0-30 cm	Sandy loam (69 % sand, 19 % silt, 12 % clay), 10 YR 3/3.
30-170 cm	Sandy loam (57 % sand, 29 % silt, 14 % clay), 10 YR 4/4.
170-250+ cm	Loam (51 % sand, 32 % silt, 17 % clay), 10 YR 4/4.

Profile 2 About 2.5 m from west end of trench. (Fig. 43).

Depth	Description
0-35 cm	Sandy loam, 10 YR 3/2.
30-70 cm	Silt loam, 10 YR 3/3.
70-140 cm	Silt loam, 10 YR 4/3.
140-230+ cm	Loamy sand, 8.75 YR 4/4.

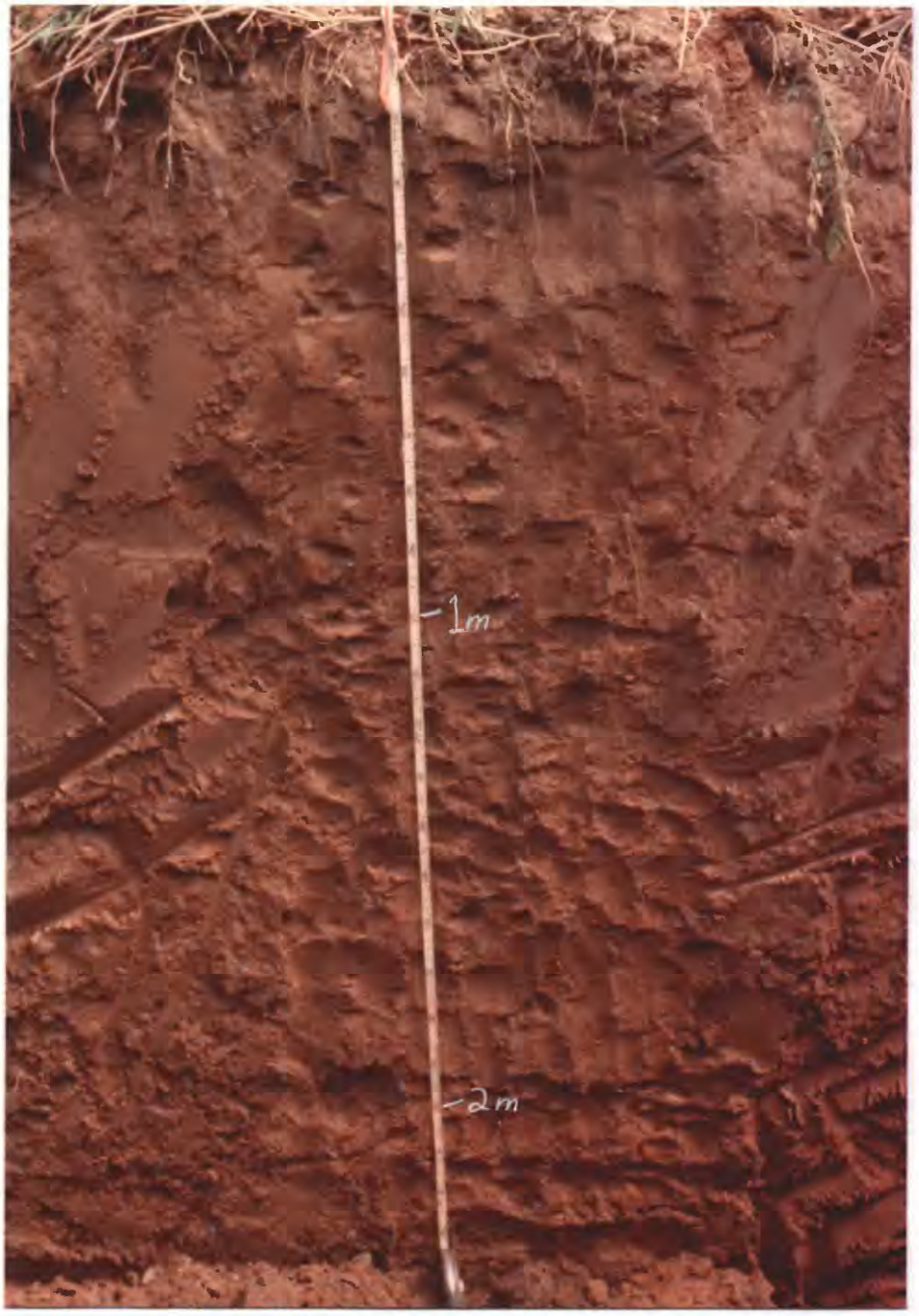

Figure 40. Trench 19, Profile 1.

Figure 41. Trench 19, showing arch-shaped slump in trench wall.

Figure 42. Trench 20, Profile 1.

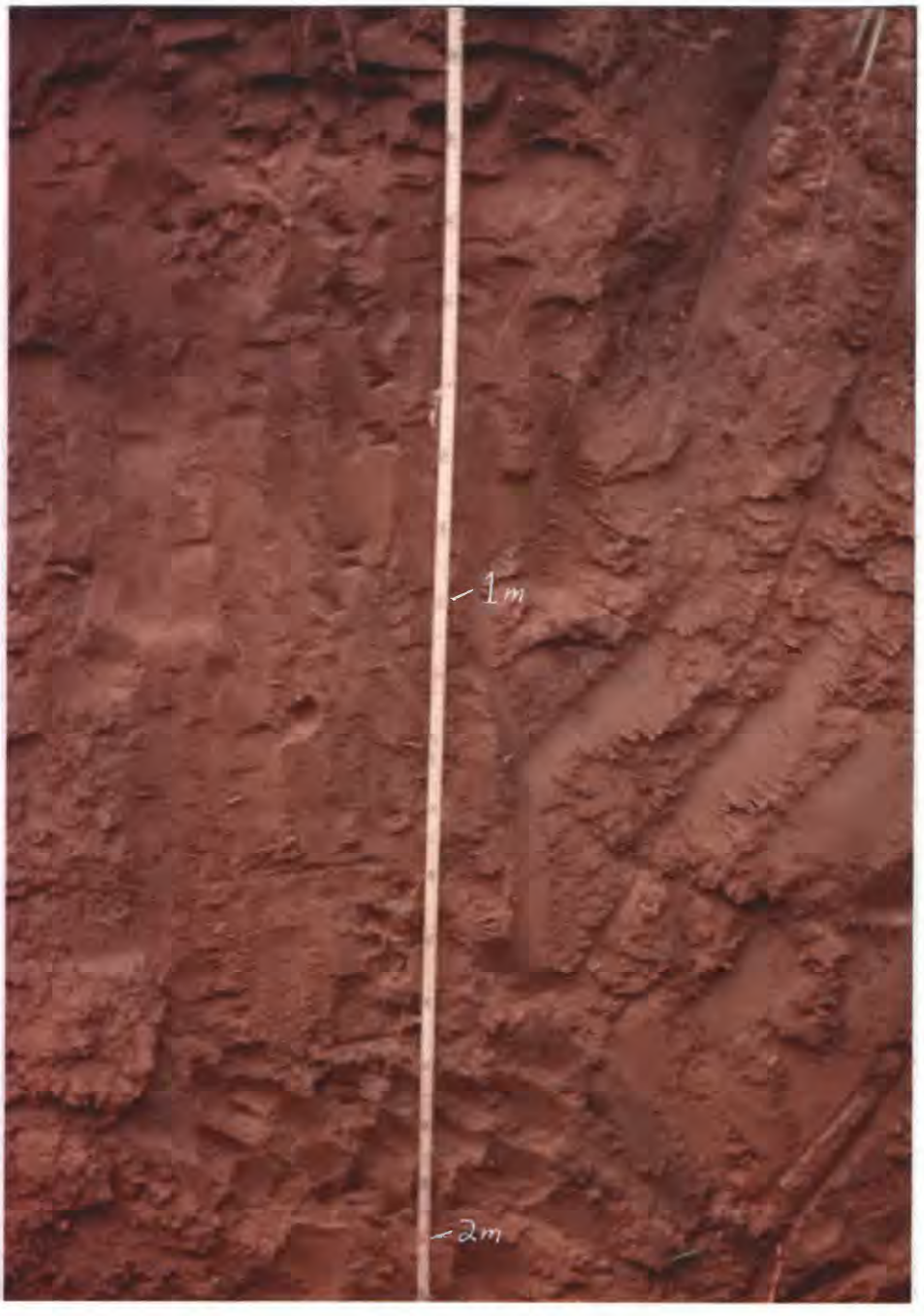

Figure 43. Trench 20, Profile 2.

Comments The profiles observed at both Trench 19 and 20 probably were the most monotonous seen during the trenching project. There was virtually no bedding, with little variation in texture or color. Almost no clasts were observed. One unique feature of these trenches was the arch-shaped slumps that occurred (Fig. 41). In other trenches, slumping occurred only where the trench floor was below the water table, or where non-cohesive gravel layers collapsed. As the particle-size distributions in profiles revealed by Trenches 19 and 20 were not unusual, perhaps the deposits here have other unusual physical properties that make them prone to slumping. As this location is near the center of the Giles County seismogenic zone (Fig. 1), perhaps these properties are ones induced by shaking. A future research project might consist of comparing geotechnical properties of New River floodplain and low-terrace sediments in the center of the seismogenic zone with those distant from the zone.

DISCUSSION

The following generalizations concerning terraces are based on observations of topography and road cuts, as well as of trenches. To facilitate discussion, terraces will be classified as low, intermediate, or high. Low is defined as less than 25 m above modern river level (AMRL), intermediate as 25-50 AMRL, and high as greater than 50 m AMRL.

With regard to topography, the low terraces have smooth, undissected surfaces. In the lower elevation range of this category, meander scrolls are common, but have become obscured in the higher range. Although terrace surfaces commonly are flat or gently sloping, alluvial deposits left on slip-off slopes can have original slopes as steep as 8°. Sinkholes are rare. The intermediate terraces commonly are dissected by small stream valleys, and sinkholes are numerous. The original terrace surface, however, commonly is evident from the concordance of areas not yet affected by fluvial dissection or sinkhole formation. The high terraces, in contrast, retain none of their original surface morphology. They are characterized by rolling, irregular topography with many sinkholes, and are dissected by large stream valleys. Risers between successive terraces have been obscured so that the number and extent of original terraces is impossible to determine.

With regard to terrace sediments, the low-terrace deposits show a low to moderate degree of weathering. The very lowest terraces in this rangle show a 10 YR hue (Munsell) and an A/C soil profile. Cambic (color) B horizons with 7.5 YR hues occur within a few meters AMRL, and argillic B horizons occur as low as 10 m AMRL. Even the highest low terraces, however, showed hues no redder than 7.5 YR. Original textures are known to vary greatly in a meandering-stream environment, tending to obscure the increase in clay content with age. Nevertheless, such an increase is evident. The B-horizon textures of the lowest terraces vary from sand to clay loam, whereas in the highest of the low terraces, clay loam and clay are common. Staining by iron-manganese oxide, in the form of films on peds and clasts, was not observed on terraces below 7 m AMRL. Clasts vary greatly in abundance, being nearly absent at some locations. With regard to clast weathering, at the lowest elevation nearly all clasts are fresh and hard; at 15 m AMRL, some sandstone clasts can be broken by hand, but other lithologies remain hard. Feldspar crystals in crystalline rocks, however, acquire a chalky appearance. The situation on the highest low terraces is similar, except that the percentage of friable sandstone clasts has increased.

Sedimentary structures exposed by trenching of low terraces were few, with most contacts between adjacent strata or soil horizons being diffuse and smooth. All stratification appeared to be primary, with no evidence of postdepositional reworking (hillslope colluvium excepted, of course). The thickness of sediments on the low terraces does not seem to be great, for of 14 trenches (all less than 4 m in depth) dug on these terraces, 4 encountered bedrock. The bedrock exposed was relatively unweathered at lower elevations, but shale exposed by one trench at 21 m AMRL was sufficiently weathered to be excavated with a shovel. Where bedrock was encountered, overlying channel gravels were exposed that contained boulders as large as 50 cm in intermediate diameter. Three trenches in swales of terraces within several meters AMRL exposed logs, samples of which were collected for radiocarbon dating. Although no dates have yet been obtained, very likely the terraces are Holocene in age. As organics were encountered only at or below the water table, it is unlikely that materials suitable for radiocarbon dating will be found on much higher terraces owing to the thin nature of the alluvial mantle.

The intermediate terraces showed a much greater degree of weathering, but variation within the 25-50 m AMRL range was somewhat less than that of low terraces. Hues ranged from 7.5 YR to 2.5 YR, but there was little apparent increase in redness with elevation. B horizons commonly show a clay texture. Iron-manganese-oxide staining was common, with thin (one to several centimeters in thickness) layers of this material occurring in many exposures. Most crystalline clasts were decomposed, as were many sandstone clasts. Alluvial deposits appeared to be thicker than those on low terraces, and no clasts as large as those in low-terrace channel gravels were observed.

Although apparently original sedimentary structures were also common, many locations showed evidence of post-depositional reworking of alluvial sediments. One obvious example was observed on erosional slopes, where slope wash and creep are active. Such slopes often show a veneer of mixed alluvium and residuum, less than 1 m thick, overlying residuum. Alternately, at one location, a stone line separated alluvial layers, suggesting reworking by slope wash. Other reworking is associated with the formation of sinkholes, resulting from the collapse or sliding of alluvium into the holes. Features indicative of such reworking include bedding too steep to be a product of stream deposition and the intimate association of alluvial layers with colluvial layers derived from residuum. Possible cave fillings were also observed.

In many cases, however, exposures reveal no structures, and it is difficult to determine whether the alluvial deposits have been reworked or not. One clue may be provided by the presence of clasts so weathered that they disintegrate when touched. Such clasts obviously could not have been moved since weathering, and thus suggest *in situ* alluvium. Conceivably, of course, such clasts might have been reworked prior to weathering, but this seems unlikely, as alluvium on low terraces is subject to little reworking of the kind under discussion. Only with the onset of fluvial dissection and sinkhole formation, confined largely to intermediate and high terraces, does such reworking become common. Additional evidence is provided by the fact that decomposed clasts are rare in obviously reworked alluvium, such as that on steep erosional slopes.

Alluvium on high terraces shows only a small increase in degree of weathering compared to that on intermediate terraces. Hues and textures are about the same, and iron-manganese-oxide occurrence is similar. Except for those composed of quartz, most clasts are highly weathered. The main difference is that much more of the alluvial deposits have been reworked, with *in situ* deposits being relatively uncommon. As most of the deposits overlie carbonate bedrock, reworking by surface wash is less common than disturbance by differential solution of the bedrock. Deposits affected directly by sinkhole formation are, of course, dramatically disturbed. Topographic inversion may result in sinkhole-fill deposits coming to occupy topographic highs. There also appear to be substantial areas that have undergone only moderate disturbance, having been affected by irregular letdown caused by solution of carbonate not associated with sinkhole formation. For example, originally flat-lying beds of alluvium may be draped over a hilltop, or may be tilted at a relatively steep angle. Such disturbance results, in addition to distortion of the beds, in jointing and faulting. These fractures may be filled by translocated fines or by iron-manganese oxides. Such moderately disturbed deposits can be preserved on surprisingly steep slopes.

On the highest terraces, the alluvium decreases in thickness as it is gradually removed by weathering and erosion. The remaining alluvium becomes increasingly mixed with residuum, until eventually the deposit is essentially residuum rather than alluvium. Only scattered quartz cobbles ("riverjacks") provide evidence of the former presence of the New River. Where the underlying carbonate bedrock is relatively pure, bedrock outcrops may be plentiful.

ACKNOWLEDGMENTS

The Western Electric Company of Radford, the N & W Railroad, W. B. Matthews, and J. A. Price kindly allowed trenches to be dug on their properties. Jennifer Lazarsky assisted ably in the field.

REFERENCES CITED

Bollinger, G. A., and Wheeler, R. L., 1982, The Giles County, Virginia, Seismogenic zone -- Seismological results and geological interpretations: U. S. Geological Survey Open-File Report 82-585, 136 p.

Soil Survey Staff, 1975, Soil taxonomy: U. S. Department of Agriculture Agricultural Handbook 436.