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THE NATURE AND EXTENT OF PEAT DEPOSITS AND POSSIBLE EFFECTS OF PEAT MINING ON MANMADE FEATURES AND SPRINGS NEAR MESCALERO, NEW MEXICO

By

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Prepared by the U.S. Geological Survey, in cooperation with the U.S. Bureau of Indian Affairs

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THE NATURE AND EXTENT OF PEAT DEPOSITS AND POSSIBLE EFFECTS OF PEAT MINING ON MANMADE FEATURES AND SPRINGS NEAR MESCALERO, NEW MEXICO

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ABSTRACT

A study was made during May 1971 by the U.S. Geological Survey to: (1) determine the nature and extent of peat deposits near Mescalero, N. Mex.; (2) determine whether mining of the peat will affect the stability of three manmade features near the deposits; (3) determine whether peat mining will affect springs.

Peat deposits with organic-matter contents between 15 and 35 percent are generally 1- to 2-feet thick and occur within 8 feet of land surface. The deposits underlie an area of about 26 acres. The total volume of peat probably ranges from 40,000 to 80,000 cubic yards.

Peat mining is not likely to affect the stability of St. Joseph's Mission because underlying sediments have been prestressed in the geologic past to tolerate possible changes. The Mescalero National Fish Hatchery is built upon soft, and saturated, silts and clays that are subject to settling under stress. Excavation beyond the toe of the 4-percent slope below the hatchery would minimize possible detriment to this feature. State Road 24 is particularly susceptible to damage because of its construction over silts and clays. Excavation not closer than 200 feet from the road would minimize possible detriment to this feature.

Springs near the study area probably have their sources in fractures of the Permian Yeso Formation. Peat mining is not likely to affect flow of these springs.

INTRODUCTION

Purpose and scope of investigation

Preliminary analyses by the U.S. Bureau of Indian Affairs of peat samples taken from two dug pits near Mescalero indicate that peat deposits in the area may have commercial value as a soil conditioner. The Mescalero Agency, Bureau of Indian Affairs, expressed interest in the nature and extent of the peat deposits. They were concerned, however, about the effects that mining may have on three manmade features, and also on springs that supply water to the town of Mescalero and to the Mescalero National Fish Hatchery.

During May 1971, the U.S. Geological Survey, at the request of the U.S. Bureau of Indian Affairs, undertook a study to: (1) determine the nature and extent of peat deposits near Mescalero (fig. 1); (2) determine whether peat extraction will affect the stability of St. Joseph's Mission, the Mescalero National Fish Hatchery, and State Road 24 (fig. 2); (3) determine whether peat extraction will affect springs (fig. 3).

Samples of peat and associated sediments were collected in seven locations with either a split-spoon drive sampler or a hand auger. Five holes were augered to determine the character and thickness of valley-fill sediments that underlie the peat deposits and the Mescalero National Fish Hatchery; four holes were augered to determine the character of material beneath State Road 24 and St. Joseph's Mission. Four seismic lines were run to help interpret the geology of the valley-fill sediments.

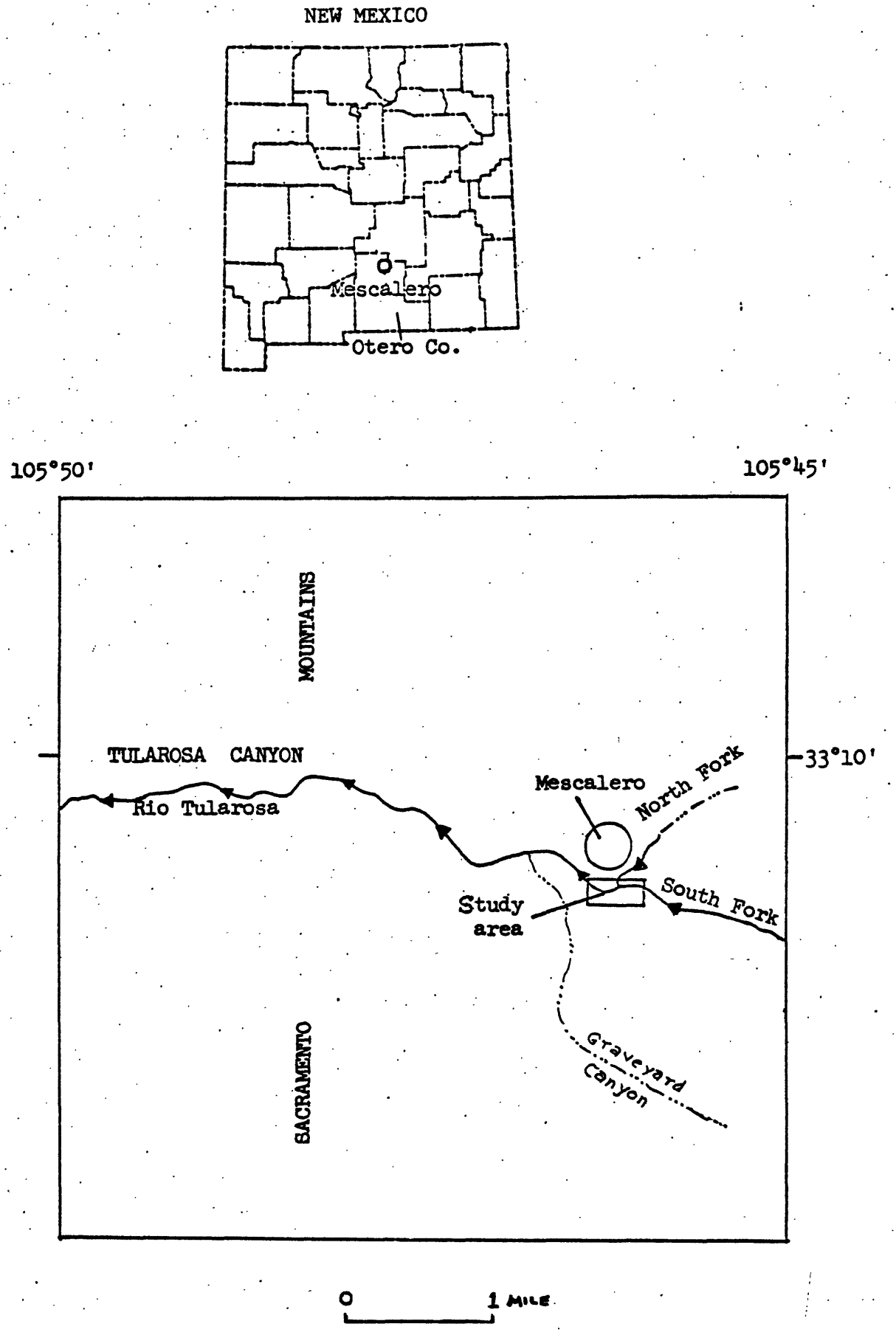

Figure 1.—Index map

Acknowledgments

Samples of peat and associated sediments were analyzed by the Soil Laboratory of the U.S. Bureau of Indian Affairs in Gallup, N. Mex. The analyses were interpreted by Mr. Lawrence Bronaugh, Supervisory Soils Scientist, Albuquerque Area Office, U.S. Bureau of Indian Affairs. Mr. Jerry Mercer, U.S. Geological Survey, conducted the seismic survey and interpreted the results.

NATURE AND EXTENT OF PEAT DEPOSITS

Results of the analyses of samples taken at seven locations (sample holes M-1 to M-7, fig. 2) are given in table 1. In reference to this table, Mr. Bronaugh, U.S. Bureau of Indian Affairs, indicated that fairly good organic materials, having an organic-matter content of 15 to 35 percent, are found in the 1- to 8-foot depths. This material does not meet the full requirements for peat, though it would be acceptable material for mulching and enrichment of normal soil textures. Mr. Bronaugh noted that the soil-fertility levels, which are determined by the nitrogen (N), phosphorous (P_2O_5), and potassium (K_2O) contents shown in table 1, are medium to high in the surface 3 feet.

The peat deposits probably underlie most of the area in the vicinity of the South Fork of the Rio Tularosa between the 6,550 foot and 6,570 foot land-surface contours shown in figure 3. This area is roughly 26 acres. Geologic data gathered from auger holes in the study area indicate that the peat deposits are associated with lake silts and clays that filled the valley to depths of 60 feet or more (figs. 4 and 5 and table 2). The peat deposits may have formed during the later stages of lake sedimentation. Springs and upward leakage from water-bearing sands and gravels under the lake deposits may also have contributed to the moist environment needed for peat formation.

Sediments in the study area were probed with an auger to depths of 30 feet in sample holes M-1, M-2, M-3, and M-4. Most of the organic matter was found in a 1- to 2-foot layer within 8 feet of the land surface, and layers of the material 6 inches thick or less were penetrated below depths of 8 feet (table 2). Apparently these layers are not continuous throughout the valley. Seismic work, illustrated in figure 6, indicated a relatively thin, low velocity, layer near the land surface, which probably is the peat layer. These data indicate that the total volume of peat in the 1- to 2-foot layer near the land surface probably ranges from 40,000 to 80,000 cubic yards.

POSSIBLE EFFECTS OF PEAT MINING ON MANMADE FEATURES

St. Joseph's Mission

St. Joseph's Mission, a large stone church that was hand built by Mescalero Indians during the 1920's, is on a hill near the area of proposed peat mining. A road excavation about 150 feet south of the mission exposes cut-and-fill sands and gravels with interbedded clays. Four auger holes (T-2a, T-2b, T-3, and T-8) drilled beside the road excavation penetrated about 20 feet of similar material (table 2). The cut-and-fill materials overlie at least 50 feet of dense clay; that adhered firmly to the auger when holes T-3 and T-8 were drilled. It is believed that the sedimentary strata under the mission are similar in character and thickness to those observed in and near the road excavation. Figure 5 shows the relative positions of the two geologic units beneath the mission.

The mission evidently sits on an eroded remnant of gravel and clay deposits that partly filled valleys of the North and South Forks of the Rio Tularosa. These deposits were eroded to considerable depth in both valleys, and the resulting channels were partly filled later with gravel, sand, and lake clays. This geologic evidence indicates that sediments under the mission have in the past been exposed to greater depths in adjacent valleys than could result from future mining for peat deposits. Also, the strata under the mission were probably prestressed naturally by overburden that was later removed by erosion. These two factors support the conclusion that peat mining would have little or no effect on the stability of the mission.

Mescalero National Fish Hatchery

The Mescalero National Fish Hatchery is built on 60 to 80 feet of saturated, soft clay (fig. 4 and table 2). The clay, which was very easy to auger, is susceptible to settling under loads. Parts of the fish hatchery have been damaged because of settling.

Excavation beyond the toe of the 4-percent slope below the hatchery would minimize possible detriment to the hatchery. This slope apparently is relatively stable at present. The effects of mining would be minimum to the west of the toe of this slope about 400 feet from the fence shown in figures 2 and 3.

State Road 24

State Road 24 has been constructed on the side of the steep cut-and-fill gravel and clay bank south of St. Joseph's Mission. Part of the road has been excavated in the bank, and part rests on fill that has been placed over saturated, soft peat, clay, and associated sediments in the valley (fig. 5). The road is particularly susceptible to settling, and a section about 100 feet long near St. Joseph's Mission collapsed during construction.

Excavation resulting in a slope of 4 percent or less would minimize the possibility of further damage. The excavation of 7 or 8 feet of peat-bearing material at 200 feet from the road would result in a 4-percent slope between the base of the road and the base of the excavated area. Presumably such a slope is relatively stable because it occurs naturally below the fish hatchery. Soil mechanics properties of clays and associated materials near the road should be laboratory tested to properly evaluate the possible effects of peat mining.

POSSIBLE EFFECTS OF PEAT MINING ON SPRINGS

Two of several springs that occur in the study area are important sources of water. North Spring (fig. 3), the headwaters of the North Fork Rio Tularosa, supplies water for the town of Mescalero. Church Spring (fig. 3) near the South Fork Rio Tularosa supplies water at the rate of about 550 gallons per minute to the Mescalero National Fish Hatchery for fish-propagation operations (Ronald Elkins, U.S. Bureau of Sport Fisheries and Wildlife, oral commun., 1971).

Both North Spring and Church Spring are near outcrops of the Permian Yeso Formation (fig. 3); the spring flows are apparently derived from fractures in the formation. There is probably little, if any, hydraulic connection between the springs and the valley fill sediments in the study area. Therefore, mining that might change water levels somewhat in the valley will have little or no effect upon the flow of the two springs. Smaller springs near the study area probably also are related to fractures in the Yeso Formation and should not be affected by mining.

SUMMARY

Peat deposits with organic-matter contents between 15 and 35 percent are generally 1- to 2-feet thick and occur within 8 feet of the land surface. The deposits underlie an area of about 26 acres. The total volume of peat probably ranges from 40,000 to 80,000 cubic yards.

Peat mining is not likely to affect the stability of St. Joseph's Mission because underlying sediments have been pre-stressed in the geologic past to tolerate possible changes. The Mescalero National Fish Hatchery is built upon soft, saturated, silts and clays that are subject to settling under stress. Excavation beyond the toe of the 4-percent slope below the hatchery would minimize possible detriment to this feature. State Road 24 is particularly susceptible to damage because of its construction over the silts and clays. Excavation not closer than 200 feet from the road should minimize possible detriment to this feature.

Springs near the study area probably have their sources in fractures of the Permian Yeso Formation. Peat mining is not likely to affect flow of these springs.

REFERENCES

U.S. Department of the Interior, Bureau of Indian Affairs, 1958: Map showing Mescalero Indian Reservation, New Mexico, Tularosa Valley topography, 8 sheets. Scale: 1 inch equals 200 feet.

Table 1.--Analyses of soil samples (Locations shown on figure 2.)

(Analyses by Bureau of Indian Affairs, Soil Laboratory, Gallup, New Mexico)

Field number	Laboratory number	Depth (feet)	Sand (percent)	Silt (percent)	Clay (percent)	Texture class[1/]	Nitrate (parts per million)	Nitrogen (pounds per acre)	Phosphorus (pounds per acre)	Potassium (pounds per acre)	Organic matter (percent)	Total Nitrogen (percent)
M-1	1925	0 - 1½	29	55	17	SiL	1.39	63.00	196.94	122.50	10.09	0.39
	1926	1½- 3	37	32	31	CL	1.02	46.00	151.14	152.65	18.76	.58
	1927	3 - 4½	41	34	25	L	.29	13.00	50.38	108.36	21.98	.74
	1928	4½- 6½	41	32	27	L	.24	11.00	50.38	55.60	8.50	.26
	1929	6½- 7½	11	42	47	SiC	.19	8.60	64.12	32.04	7.26	.25
	1930	7½- 9	19	50	31	SiCL	.04	2.00	99.84	60.31	4.02	.15
	1931	9 -11	37	42	21	L	.04	2.00	64.12	73.50	3.29	.11
	1932	11 -13½	21	48	31	CL	.04	2.00	108.09	100.83	5.40	.19
	1933	13½-15½	41	34	25	L	.11	5.00	Trace	49.00	16.50	.66
	1934	15½-20	29	42	29	CL	Trace	Trace	123.66	43.35	3.29	.11
	1935	20 -21	38	38	24	L	.04	2.00	91.60	52.77	8.62	.29
M-2	1936	0 - 2	35	40	25	L	-	420.00	28.40	110.25	4.71	.25
	1937	2 - 3½	35	38	27	CL	-	1,160.00	99.84	143.23	17.67	.60
	1938	3½- 7½	21	46	33	CL	.24	11.00	Trace	107.42	6.43	.21
	1939	7½- 9	31	42	27	CL	.11	5.00	Trace	86.69	6.21	.18
	1940	9 -11½	37	36	27	CL	.11	5.00	64.12	50.88	9.48	.29
	1941	11½-15	47	30	23	L	.11	5.00	43.05	92.35	12.24	.35
M-3	1942	0 - 1	35	46	19	L	1.70	77.00	108.09	103.65	3.83	.12
	1943	1 - 2½	17	50	33	SiCL	1.33	60.00	59.54	67.85	6.99	.29
	1944	2½- 3½	31	64	5	SiL	.24	11.00	50.38	130.04	15.67	.38
	1945	3½- 4½	71	18	11	SL	.35	16.00	13.74	111.19	12.81	.25
	1946	4½- 6	63	20	17	SL	.11	5.00	4.58	60.30	6.71	.16
	1947	6 -10	33	40	27	CL	.19	8.60	Trace	96.11	8.71	.25
	1948	10 -12	37	38	25	L	.24	11.00	Trace	25.44	10.29	-
	1949	12 -15	43	40	17	L	.11	5.00	20.15	13.19	11.24	.33

Table 1.--Analyses of soil samples - Concluded

Field number	Laboratory number	Depth (feet)	Sand (percent)	Silt (percent)	Clay (percent)	Texture class 1/	Nitrate (parts per million)	Nitrogen (pounds per acre)	Phosphorus (pounds per acre)	Potassium (pounds per acre)	Organic matter (percent)	Total Nitrogen (percent)
M-4	1950	0 - 1½	17	50	33	SiCL	3.54	160.00	43.05	150.77	7.28	0.34
	1951	1½- 2½	37	38	25	L	.95	43.00	28.40	118.73	11.50	.37
	1952	2½- 4	43	30	27	CL	.29	13.00	73.28	147.00	33.60	.75
	1953	4 - 6½	51	44	5	SL	.29	13.00	43.05	58.42	19.12	.47
	1954	6½- 9½	36	38	26	L	.42	19.00	20.15	73.50	16.03	.48
	1955	9½-11½	17	62	21	SiL	.11	5.00	64.12	82.92	7.96	.25
	1956	11½-13½	23	47	30	CL	.19	8.60	82.44	73.50	4.17	.17
	1957	13½-15	31	41	28	CL	.11	5.00	108.09	96.11	6.45	.22
M-5	1958	0 - 1	39	43	18	L	.49	22.00	59.54	184.69	11.14	.43
	1959	1 - 3	41	35	24	L	.35	16.00	43.05	98.00	24.12	.66
	1960	3 - 5	41	35	24	L	.24	11.00	64.12	96.11	27.49	.71
	1961	5 - 8	31	39	30	CL	.24	11.00	50.38	86.69	18.98	.52
M-6	1962	0 - 1½	39	45	16	L	.19	8.60	99.84	71.61	10.17	.37
	1963	1½- 2½	53	31	16	SL	.11	5.00	20.15	58.42	12.59	.33
	1964	2½- 4	45	31	24	L	.11	5.00	50.38	109.31	35.36	.77
	1965	4 - 7	35	43	22	L	.11	5.00	123.66	35.81	17.00	.49
M-7	1966	0 - 1	25	51	24	SiL	1.55	70.00	82.44	440.99	4.83	.24
	1967	1 - 2	29	43	28	CL	1.48	66.60	50.38	148.88	5.50	.24
	1968	2 - 3½	43	39	18	L	.95	43.00	59.54	90.46	10.45	.38
	1969	3½- 4½	43	35	22	L	.04	2.00	35.72	98.00	7.41	.23
	1970	4½- 7½	37	37	26	L	.11	5.00	73.28	86.69	15.88	.42

Note:

Concentration ranges	Low	Medium	High
Nitrogen	0-40	40-80	80
Phosphorus	0-25	25-50	50
Potassium	0-120	120-240	240
Organic matter	0-1.0	1.0-2.0	2.0

1/ CL, clayloams
L, loams
SiC, silty clay
SiCL, silty clayloams
SiL, siltloams

Table 2.—Driller's logs of auger holes near Mescalero, N. Mex.

(Locations shown on figure 2.)

Hole No.	Depth (feet)	Description of material
		Lake unit
T-1	0-51	Clay, black; very easy augering.
	51	Clay; thin, hard lens.
	51-53	Clay; easy augering as 0-51.
	54	Clay; thin, hard lens.
	54-62	Clay, black; slightly harder augering than 0-51.
		Gravel unit
	62-76	Clay, color change, lighter than above; possibly sandy.
	76-83	Gravel and clay interbedded.
		Dense clay unit
	83-100	Siltstone, brown pebbly, clung firmly to auger during removal from hole. Smooth augering, harder than above. Clay, very hard; smooth augering; progress nearly stopped at 100 feet.
		Yeso Formation
	100-101	Siltstone, reddish-brown, on auger bit after removal from hole.
	Note: Hole T-1 flowed 15 gallons per minute upon completion.	
		Cut-and-fill unit
T-2a	0- 7	Clay and gravel.
	7-12	Clay; sticky, brown, removed by spinning auger rapidly. Easy augering.
	12-19	Gravel and light-brown clay. Siltstone, yellowish, and limestone chips clung to auger bit. Very hard drilling, bit shattered on hard rock at total depth.

Table 2.--Driller's logs of auger holes near Mescalero, N. Mex. - Continued

Hole No.	Depth (feet)	Description of material
		Cut-and-fill unit
T-2b	0-20	Same as T-2a.
	20	Progress stopped by hard rock as in hole T-2a.
		Cut-and-fill unit
T-3	0-12	Clay removed from hole by spinning auger. Smooth augering.
	12-21	Gravel, very coarse at 21 feet.
		Dense clay unit
	21-41	Clay, yellowish-brown, dense, clung to auger in this interval. Smooth augering.
	41	Clay, dense thin hard layer.
	41-61	Clay, brown, dense, clung to auger in this interval. Smooth, easy augering.
	61-71	Clay, yellowish-brown, dense, clung to auger in this interval. Smooth, easy augering. Augering terminated at 71 feet in anticipation of encountering water under artesian head.
		Lake unit
T-4	0-15	Clay, black; easy augering.
		Slope wash
	15-17	Gravel.

Table 2.—Driller's logs of auger holes near Mescalero, N. Mex. - Continued

Hole No.	Depth (feet)	Description of material
		Valley fill
T-5	0-11	Gravel and fill.
		Lake unit and valley fill
	11-51	Clay, dark, brought up by rotation. Very easy, smooth augering.
		Lake unit
	51-56	Clay, smooth; easy augering; mud flowed while augering.
	56-61	Clay, smooth; easy augering; mud stopped flowing.
	61-86	Clay, smooth; easy augering; no materials brought out of hole while spinning auger.
		Gravel unit
	86-98	Gravel layers; harder augering.
		Yeso Formation
	98-99	Siltstone, reddish-brown, on auger bit, very hard; progress almost stopped.
	Note:	Water level in hole T-5 was about 2 feet below the land surface upon completion.
		Lake unit
T-6	0-12	Peat, with dark mud, brought up while spinning auger. Very easy augering.
	12-42	Clay, dark, brought out while spinning auger. Easy augering.
	42-47	Clay, easy augering; water started flowing while augering.
	47-60	Clay, easy augering; water stopped flowing.
		Gravel unit(?)
	60-68	Clay; slightly harder augering.
		Alluvial fan unit
	68-102	Clay and gravel units alternating.
		Yeso Formation
	102	Siltstone, reddish-brown; very hard, smooth augering.
	Note:	Hole T-6 flowed 1 gallon per minute upon completion.

Table 2.--Driller's logs of auger holes near Mescalero, N. Mex. - Continued

Hole No.	Depth (feet)	Description of material
		Lake unit
T-7	0-17	Clay, sticky gray, while rotating auger. Smooth, easy augering.
		Slope wash
	17-28	Gravel layers; mostly easy augering.
		Yeso Formation
	28-29	Siltstone, reddish-brown, on bit upon removal from hole. Hard, smooth augering.
		Cut-and-fill unit
T-8	0-20	Gravel with interbedded clays.
		Dense clay unit
	20-25	Clay, with thin hard layers; smooth augering.
	25-34	Clay; smooth augering.
	34-35½	Clay, brown and yellow; split-spoon sample.
	35½-49	Clay; smooth augering.
	49-50½	Clay, brown; split-spoon sample.
		Lake unit
M-1	0- 6	Soil and peat; 1 to 2 feet of peat in this interval.
	6-13	Clay, dark; about 6 inches of peaty material near base.
	13-30	Clay, dark; two very thin (2-inch) organic layers in this interval.

Table 2.—Driller's logs of auger holes near Mescalero, N. Mex. - Concluded

Hole No.	Depth (feet)	Description of material
		Lake unit
M-2	0- 5	Soil and peat; 1 to 2 feet of peat in this interval.
	5-10	Clay, dark.
	10-15	Clay, dark; some peat.
	15-30	Clay, dark, with very minor peat; some harder layers of light-gray silt.
		Lake unit
M-3	0- 4	Soil; nothing on auger.
	5-10	Clay, dark; and about 2 feet of peat.
	10-15	Clay, dark.
	15-25	Clay, sandy; lighter color than above.
	25-30	Sand, white; minor thin peaty layers.
		Lake unit
M-4	0- 4	Soil; nothing on auger.
	4- 5	Clay, dark.
	5- 7	Peat.
	7-12	Clay, dark.
	12-21	Clay, gray; lighter color than above.
	21-22	Clay; thin layer of peat. Peat has strong decaying odor.
	22-30	Clay, soft, dark; some sandy; minor organic matter in clay.

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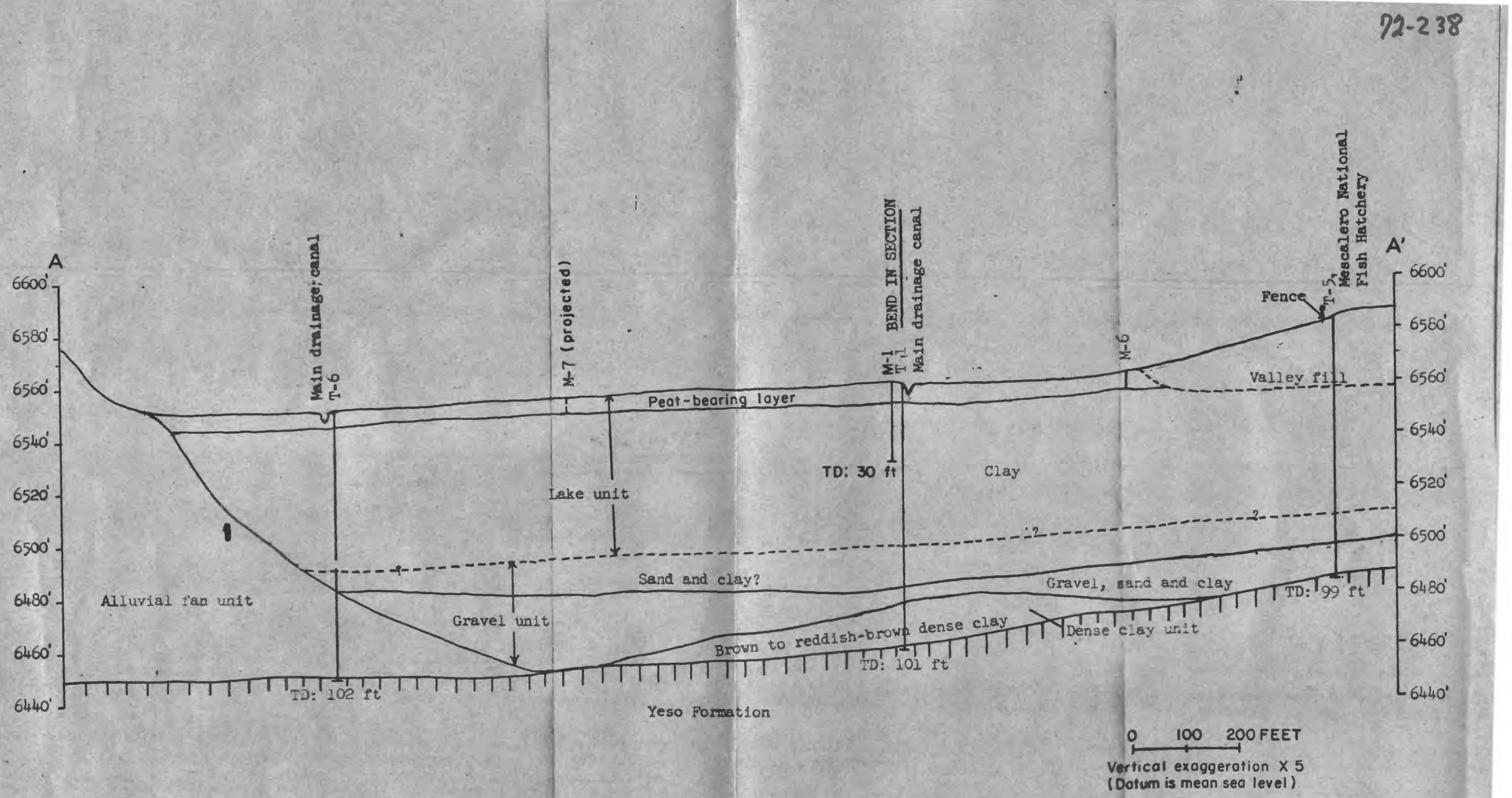

Figure 4. Section A-A' showing stratigraphic relations of unconsolidated deposits near Mescalero, Otero County, New Mexico.

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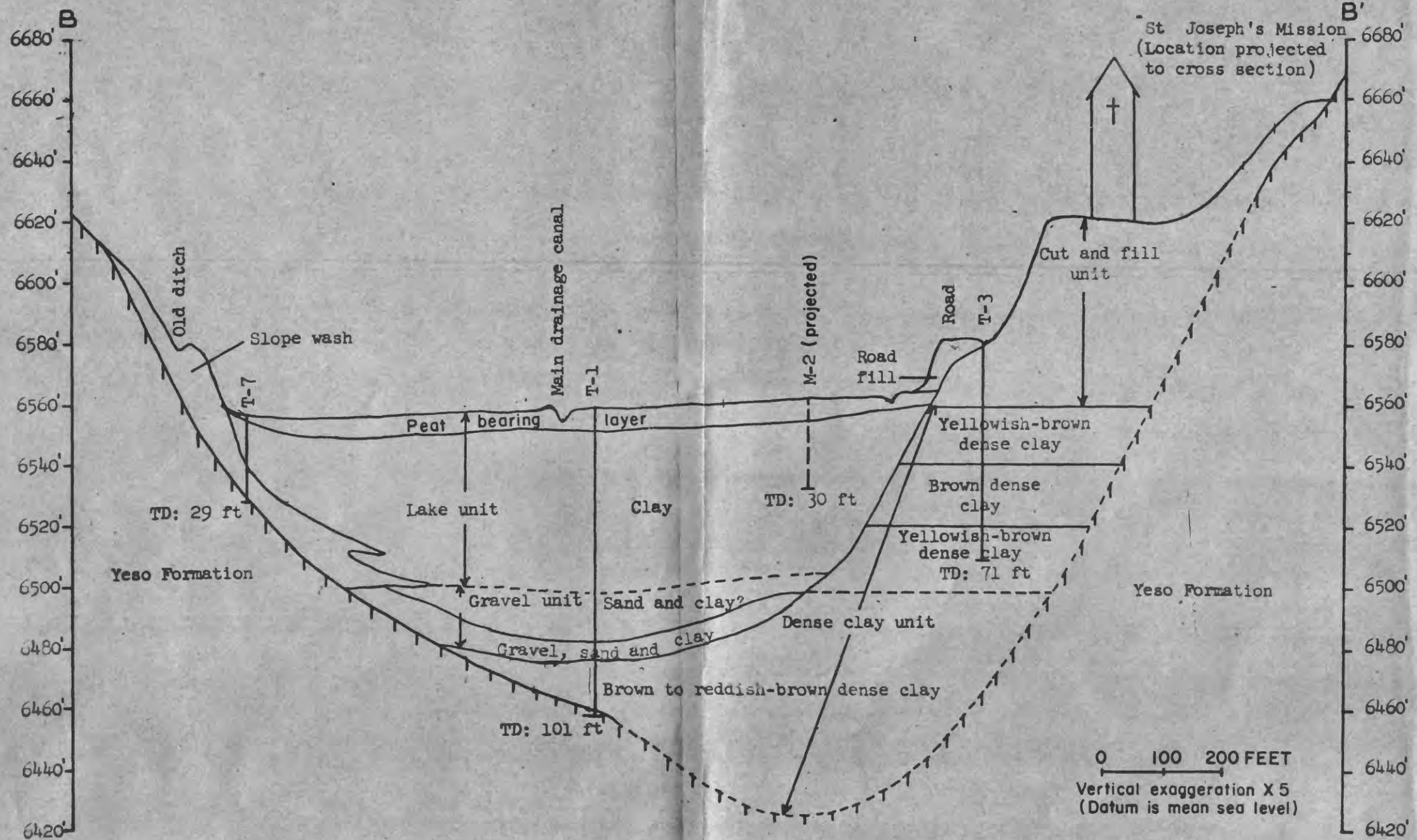

Figure 5. Section B-B' showing stratigraphic relations of unconsolidated deposits near Mescalero, Otero County, New Mexico.

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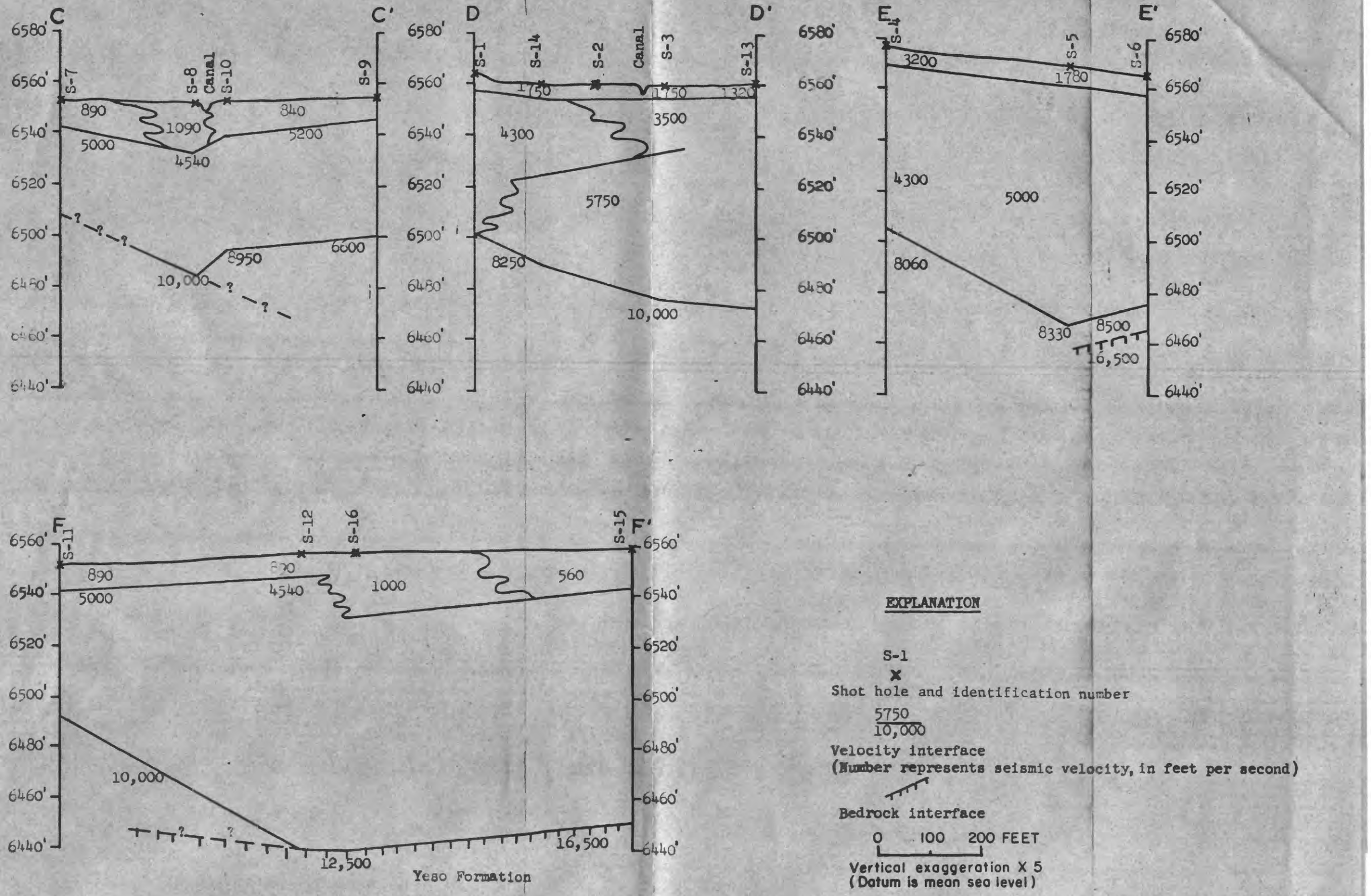

EXPLANATION

S-1
×
Shot hole and identification number

5750
10,000
Velocity interface
(Number represents seismic velocity, in feet per second)

Bedrock interface

0 100 200 FEET
Vertical exaggeration X 5
(Datum is mean sea level)

Figure 6.--Seismic sections C-C', D-D', E-E', and F-F' showing velocity interfaces in valley fill and depth to bedrock near Mescalero, Otero County, New Mexico.

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105°46'

EXPLANATION

⊙ T-1
(Auger samples)
△ M-1
(Auger and split-spoon samples)
Auger hole and identification number

X S-1
Seismic-shothole and identification number

Study area

A — A'
B — B'
Stratigraphic section
(Figures 4 and 5)

C — C'
D — D'
E — E'
F — F'
Seismic section
(Figure 6)
0 200 FEET

70

HIGHWAY

U. S.

← To Mescalero

North Fork Rio Tularosa

Center Sec. 27, T. 13S. R. 12E.

St Joseph's Mission

Drainage Ditch

Rio Tularosa

33°09'15"

Approximate Location of State Road 24

T-2a T-2b T-3 T-8

Fence (approximate position)

Mescalero National Fish Hatchery

South Fork Rio Tularosa Main Drainage Canal

Old Ditch

Main Drainage Canal

T-7

T-4

T-5

T-6

M-1 M-2 M-3 M-4 M-5 M-6 M-7

S-1 S-2 S-3 S-4 S-5 S-6 S-7 S-8 S-9 S-10 S-11 S-12 S-13 S-14 S-15 S-16

A A' B B' C C' D D' E E' F F'

105°46'

Base from U. S. Department of Interior, Bureau of Indian Affairs, 1958

Compiled by F. P. Lyford, 1971

Figure 2.--Map showing study area, location of auger holes, seismic shot holes, and lines of sections, near Mescalero, Otero County, New Mexico.

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105°46'

EXPLANATION

Qv	Valley fill and slope wash, undifferentiated: includes valley fill sand, silt, and clay and slope wash sand and gravel.	Quaternary
Ql	Lake unit: includes sand, silt, and clay with peat-like layers deposited in a lacustrine environment.	
Qa	Alluvial fan unit: includes gravel, sand, and silt deposited at the mouth of Graveyard Canyon.	
Qc	Cut and fill unit: includes gravel, sand, silt, and clay, with scattered vertebrate and invertebrate fossils.	
Ti	Igneous intrusive: strongly weathered trachyandesite porphyry.	Tertiary (?)
Py	Yeso Formation: includes consolidated beds of reddish-brown siltstone, and gray to brownish-gray limestone, and minor weathered gypsum.	Permian
	Road fill.	

Contact
Dashed where approximate

A — A' Stratigraphic section (Figures 4 and 5)

Spring

0 200 FEET

Contour interval 10 feet
Datum is mean sea level

33°09'15"

Base from U.S. Department of Interior, Bureau of Indian Affairs, 1958

Compiled by F.P. Lyford, 1971

Figure 3.--Generalized geologic map showing land-surface contours, springs, and lines of stratigraphic sections, near Mescalero, Otero County, New Mexico.