Proceedings of the Iowa Academy of Science

Volume 63 | Annual Issue | Article 51

1956

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Introduction

The study of four Alaskan areas was begun in the summer of 1954 under a program sponsored by the Office of Naval Research. The Iowa State College Engineering Experiment Station directed the study in collaboration with the Department of Geology, Iowa State College. The program was initiated to:

1. Determine the distribution of engineering soil materials in four Alaska areas.
2. Determine the engineering properties and trafficability characteristics of these materials.
3. Determine the feasibility and best methods of stabilizing these materials for use as road and airfield building material.
4. Further the studies of geology of Alaska.
5. Attempt a correlation of the engineering and geologic properties of the Alaskan materials with similar materials in the Midwest United States.

The investigation includes the silts of the Matanuska Valley, Big Delta, and Fairbanks regions, and the beach deposits and physiography of the Point Barrow region. The areas of study are shown on the map, Figure 1. The report considers only the first three regions, and summarizes the work done during the first contract year, 1 June, 1954 to 1 June, 1955.

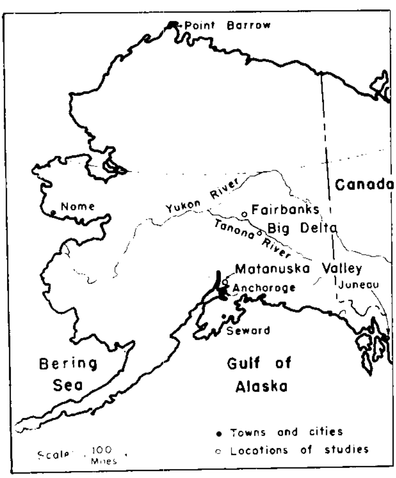

Figure 1. Locations of the three areas of study.

Included in this report are data collected during the field season of 1954 and data derived from laboratory tests of samples collected at this time. The data are subject to change when information gathered during the summer of 1955 is analyzed. Major conclusions can not be drawn until work now in progress is completed.

Matanuska Valley

The Matanuska Valley is a small agricultural area located about 50 miles north of Anchorage. It is bounded on the north by the Little Susitna River and the Talkeetna Mountains, on the east by the Chugach Range, and on the south by the Knik River and Knik Arm. The major area included in this study (see Figure 2) is east of Wasilla Creek, although some work was done near the town of Wasilla.

This study encompasses the eastern physiographic units defined by Trainer[1]. The work done in the vicinity of Wasilla is in the eastern part of the Little Susitna—Goose Bay morainic area, as shown in figure 2. Figure 3 is a picture of the valley looking north from Bodenburg Butte.

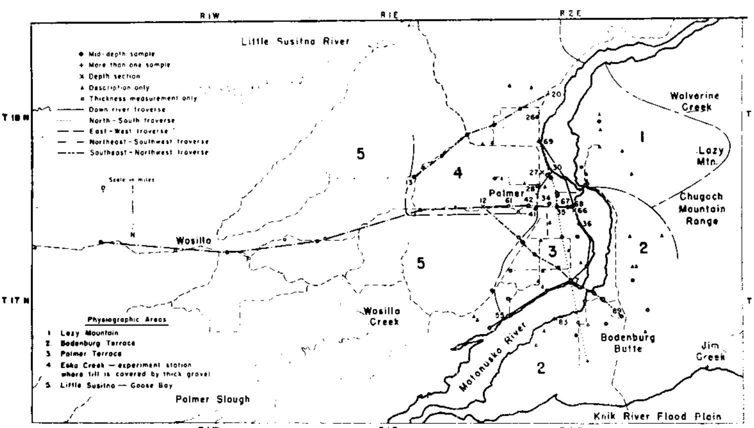

Figure 2. The Matanuska Valley area showing the locations of the traverses and sections. Numbered locations are referred to in the text.

The Matanuska Valley was studied in some detail by the field party during the summer of 1954. Because of logistic difficulties, more time was spent here than had been intended, and less time was available for study in the other areas.

Sampling

Sample locations were selected along five traverses and also in a grid pattern. Additional samples were secured from other areas for the purpose of correlation. The traverses and sample localities are shown in Figure 2. The grid pattern was made by sampling at section corners wherever possible. This plan was necessarily modified because some section corners could not easily be reached by road or on foot. Four depth sections were sampled at regular depth intervals. Other samples taken were from the Knik River floodplain, from a dust-collection box raised off the ground, and from recent deposits of wind-blown silt, all in the immediate vicinity of Jim Creek. Various special samples of white ash layers, fossils, and buried wood were also taken.

Road cuts were utilized for sampling whenever possible; roadside sampling was supplemented by augering. Many of the samples were taken at mid-depth in the silt in an attempt at stratigraphic uniformity. These mid-depth samples were obtained by first determining the thickness of the silt and then reaugering if necessary to remove a sample at mid-depth.

Descriptions of the sections were recorded at all sample locations and at other points where correlation was needed. Field density

Figure 3. The Matanuska Valley looking north from Bodenburg Butte.

tests were also made at various depths at the four depth section locations.

Fifty-two of the 91 samples taken in the Matanuska Valley and returned to the Engineering Experiment Station for analysis were mid-depth samples. Of the 52 samples, three were selected as representative of the silt of the area and were taken in quantities large enough to allow detailed engineering properties tests. These three representative samples are M7, M13, and M66-5. M7 and M13 are representative of the dominant type of silt found throughout the area, and M66-5 represents the sandier material present near the Matanuska River.

Occurrence and Thickness

The major portion of the silt in the Matanuska Valley is found in the Palmer Terrace, Bodenburg Terrace, Lazy Mountain, and

Eska Creek—Experiment Station areas[1] where it occurs as a surficial deposit. East of the Matanuska River, in the Lazy Mountain area, the silt thinly mantles old river terraces. Northeast and east of Bodenburg Butte, it may be absent with irregular patches of gravel forming the surface material. Where present in this area, the silt is commonly less than two feet thick. North of Bodenburg Butte to the Matanuska River, it is continuous and over seven feet thick.

West of the river the silt is more extensive. North of an east-west line running slightly south of Palmer, Wasilla Creek marks the approximate boundary of the silt less than two feet thick. South of this line, the two-foot boundary would lie approximately along the western boundary of the Palmer Terrace. Figure 4 is an isopachous map showing these thickness relationships.

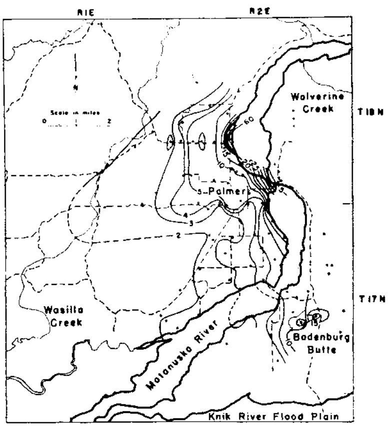

Figure 4. Isopach map of the silt thickness. Contour intervals one, five, and ten feet.

The thickest section measured is at station M69, on the right valley wall of the Matanuska River one mile north of Palmer, at the extreme west bend of the river. Here the surficial material is 60.7 feet thick and consists of sand. The appearance of five ash layers suggests the possibility that it is contemporaneous with the silt farther south. Southward along the river the thickness decreases. The river traverse begins at this maximum thickness; the decrease in thickness downstream is shown in Figure 16a.

The decrease in thickness to the west is shown in Figure 16c, the east-west traverse and in the east-west cross section, Figure 5. The decrease is rapid for a short distance from the river and then diminishes more slowly with greater distance. West of Wasilla Creek, the silts are very thin. The east-west section (see Figure 5) shows that the thicker sections are not expressed topographically as hills, for the ground surface is approximately level up to the river's edge. The isopachs greater than two feet show a tendency to parallel the river, but in the northern part of the area, the two-foot contour line extends farther west. This is similar to the iso-percentage lines for clay and sand to be discussed later.

The silt generally occurs as a mantle covering both hills and

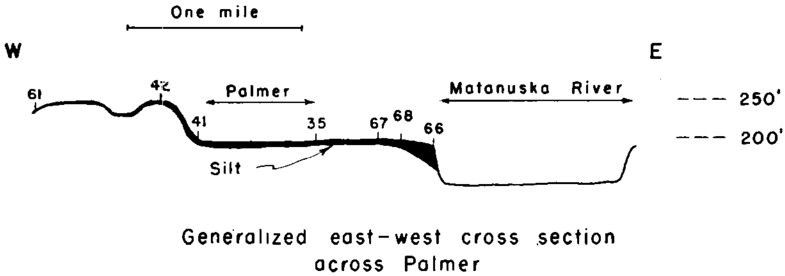

Figure 5. East-west cross section of silt through Palmer.

valleys, but the thickness may vary locally. On a knob on the east flank of Bodenburg Butte, 23.5 feet of silt was augered. This was the greatest thickness found south of Palmer. Trainer[2], p. 79, found 10 inches of silt on a hill top east of Pittman, and 68 inches in the adjacent valley.

Field Description

The Matanuska Valley silts are generally gray in color, although shades of brown and red-brown are found. The different colors form layers with generally fairly sharp contacts. There is also some mottling.

The silt will stand in vertical cuts. Figure 6 shows the manner in which the silt mantles the slopes as well as the flat areas at station M27. Some downslope movement was indicated by disarrangement of the stratification, but no quantitative appraisal could be made of the movement.

Stratification. A faint stratification is present throughout the material. This stratification is more pronounced in sandier sections, one of which is shown in Figure 7. Figure 8 is a picture showing the stratification in detail. Often the stratification is broken and appears to be deformed.

Sand dunes. Trainer[2], p. 18, describes sand dunes in four areas of the Matanuska Valley: between Fish Creek and Goose Bay, on the bluff west of Moose Creek, near Jim Creek, and along the Matanuska River bluff north of Palmer. The last two of these are within the area of this study and were observed by the field party during the summer of 1954.

Immediately west of the Jim Creek dunes described by Trainer, Jim Creek enters the unforested part of the Knik River floodplain and flows east along the forested border. No dunes are present west of the creek due to the sorting action of the creek. Material carried by the north-west trending Knik wind must cross the creek to travel farther. The creek effectively traps the particles moving by saltation and only the finer material moving in suspension passes over the creek.

The sand dunes along the Matanuska River bluff north of Palmer are cliff-head dunes imposed on the thick, coarse material such as at M69. Trainer[2], p. 71, describes these dunes as oval or irregular in plan and up to 30 feet high. Figure 9 shows the eastern part of the dune overlying bedded sand. Figure 10 is a picture of the north-south road through the dune a short distance farther southwest.

Underlying material. Gravels underlie almost all of the silt west of the Matanuska River. These gravels are generally very coarse, consisting largely of boulders and cobbles, but local sandy gravels are present. Figure 11 illustrates the sharp contact between the silt and the gravel. South of the river in the vicinity of Bodenburg Butte, bedrock is found directly underneath the silt. East of the river between Wolverine Creek and the highway bridge crossing the river, the underlying material is gravel or glacial till.

Figure 6. Silt mantling a terrace scarp at M27.

Figure 7. Stratification in the sandy silt at M30.

Figure 8. Detailed picture of stratification at M30.

Figure 9. Dune overlying silt at M69.

Figure 10. Roadcut through cliff-head dune southwest of M69.

Figure 11. Sharp gravel-silt contact.

The basal portion of the silt is often gritty or sandy, and pebbles and cobbles are present in the basal material where the silt lies on slopes. Sand layers are also found within the silt at several locations.

Concretions. Ferric iron concretions, found in several of the silt sections, are round and small, and generally less than 2 mm. in diameter. The iron oxides apparently act as a cementing agent, binding fine particles together.

The Matanuska Valley silt is not ordinarily calcareous. In this respect, it is unlike the loess of the Midwest United States, in which carbonates are generally abundant. Some calcareous concentrations were found in thin lenses in the Matanuska Valley silt; these were found only in sections in which were found carbonate—shell fossils (see Figure 12).

Figure 12. Carbonate fossils forming calcareous silt.

Ash layers. Interbedded with the silt are five and possibly six separate layers of volcanic ash. Five bands are generally discernable in the thicker silt sections in the eastern part of the area. Two are present together near the base of the section, two together are higher in the section, and the upper ash in a single layer. A sixth thin, discontinuous ash band was found at location M66 several feet below the upper single layer. Figure 17 shows the location of the ash layers in the four depth sections.

The ash may be pinkish-white, white, or yellowish-white in color. Pinkish-white color predominates in the thicker silt sections. In the thicker silt sections the bands are fairly continuous and follow the bedding pattern. The layers are more discontinuous, more contorted, and generally thinner in the thinner silt to the west and south. Here all the bands are usually not discernable. Many of them are broken and discontinuous. Figure 13a shows an ash layer and 13b shows how they may be deformed.

The ash commonly occurs with a finer-grained silt, containing more organic matter than the silt above and below. In thicker sections, the ash containing horizons are finer-grained and contain

Figure 13. Ash layers in the silt. A, above, ash layer at M55; B, below, contorted ash layer at M28.

abundant lenses of organic matter. There are seven such horizons at M69, three of which contain ash bands. In the thinner sections, the ash commonly occurs with thin brown and reddish-brown bands and charcoal lenses.

A preliminary microscopic examination of several of the ash samples shows its volcanic origin. Volcanic glass shards are present in ash samples, but none are present in silts immediately above one of the ash layers examined. Some of the minerals are in the process of alteration to clay. The ash layers may be an excellent method of correlating the silt in the thicker silt sections within the Matanuska Valley.

Soil formation. The soils in the Matanuska Valley should be dominantly podzols, since the climate is cool and humid and the vegetation is conifer; but the thicker silt formations of the Matanuska Valley are marked by their absence of podzol profile. Some faint traces of podzol horizons are found in some sections, generally where the silt is thin. Kellogg and Nygard[3] found sub-arctic brown forest soils to be dominant in the area of study.

Section descriptions. Descriptions of all sections where samples were taken were recorded in the field. Other sections were recorded for correlation purposes. Figure 2 shows the location of the described sections. The sections described below are considered representative of the Matanuska Valley silt. Though section M69 is atypical. it is considered an important section and is also described.

The three large-quantity representative samples for detailed study were taken at locations M7, M13, and M66.

Section M7. 0.4 mi. S of the NE corner of Sec. 16, T17N, R2E. This section shows very weak soil profile development.

Unit		Thickness
11	Root mat, brown, A^0 horizon	4″
10	Silt, gray incorporated in a mat	5″
9	Organic layer, dark grown	.25″
8	Silt, gray with red mottles	1.0″
7	Silt, dark brown with an orange middle layer, charcoal present	.5″ to 1.5″
6	Silt, gray with red mottles	8″
5	Silt, medium gray, discontinuous layer	1.5″
4	Ash, white	1″
3	Silt, similar to unit 5	5″
2	Silt, light reddish-brown, charcoal present at bottom	2″
1	Silt, bright yellowish-red	2′0″
	Gravel	

Section M13. SE corner of Sec. 27, T18N, R1E. This section was taken at a road cut on the Brasil Springs road.

Unit		Thickness
9	Silty root mat, medium brown, with decomposed, thin black layer at bottom	2″
8	Silty, gray, spongy	1.5″
7	Silt, medium gray with reddish-brown mottles	6.5″

6	Silt, dark reddish-brown, discontinuous layer	1.5″
5	Silt, similar to unit 7	3.5″
4	Silt, light yellowish-orange	1″
3	Sandy silt, reddish-brown with gray mottles and small iron concretions	4″
2	Silt, light yellowish-orange	1″
1	Sandy silt, medium orange-brown, gravel mixed in lower part	1′3″
	Gravel	

Section M66. NW¼ of Sec. 3, T17N, S2E. This section was taken on the Matanuska River bluff.

Unit		Thickness
11	Silt, light brownish-gray, contains lenses of fine sand, buried roots, and layers of wood. There is less wood in bottom 3′. Small snails are present in horizontal rusty layers of carbonate .25 to one in. thick.	11′2″
10	Ash, white, continuous layer	0.5″
9	Silt, medium brown with gray mottles, contains lenses of fine to medium sand, fossiliferous as in unit 11	2′2″
8	Ash, white, thin discontinuous layer, associated with bright reddish-brown to black organic separations and charcoal	1″
7	Similar to unit 9	2′6″
6	Ash, pinkish-white, in two fairly continuous layers	0.5″
5	Silt, grayish-brown, contains lenses of fine sand and black organic separations	6″
4	Sandy silt, gray with reddish-brown mottles, black organic separations as in unit 5	1′4″
3	Ash, white, in two layers over a black and dark red-brown layer, layers are contorted, charcoal is present	1′6″
2	Silt, gray with reddish-brown mottles, reddish-brown color predominating in lower part	1′6″
1	Interbedded fine and coarse sand, medium brown, coarse sand occurs in lenses	2′7″
	Gravel	

Four representative sections were sampled at progressive depth intervals. These were locations M12, M27, M66, and M83.

Section M12. 0.1 mi. E of NW corner of Sec. 6, T17N, R2E. This section was taken at a cut on hilltop, N. side Wasilla road two miles W. of Palmer.

Unit		Thickness
11	Silt, medium grayish-brown, rooty	4″
10	Silt, medium reddish-brown	5″
9	Silt, light gray	6″
8	Silt, light orange-brown	3″
7	Silt, light gray, brownish in upper part	9″
6	Ash, chalky white, continuous layer	0.5″
4	Silt, bright orange-brown, lower part is dark red-brown	3″
3	Ash, yellowish-white, discontinuous layer, charcoal is present	0.5″
2	Silt, medium gray, contains discontinuous horizontal red-brown bands 0.5 inches thick	4″
1	Silt, upper part medium yellowish-brown, lower part light brown. There is much mixing with underlying coarse sand and gravel throughout this layer	8″
	Sand and gravel, coarse	

Section M27. 0.1mi. N of SW corner of Sec. 28, T18N, R2E. Roadcut near scarp of high terrace on highway ½ mi. N. of Palmer.

Unit		Thickness
9	Silty root mat	8″
8	Silt, light gray, very friable	1′4″
7	Ash, pinkish-white, continuous layer	0.5″
6	Silt, gray-buff, contains dark brown discontinuous organic separations that are 2 to 6 inches apart and 0.25 inches thick	2′5″
5	Ash, pinkish-white	1″
4	Silt, reddish-brown with gray mottles	1′7″
3	Ash, pinkish-white, discontinuous layer	0.5″
2	Silt, similar to unit 4 but with mottles fairly horizontal	1′3″
1	Sandy silt, red-brown, upper 2 inches dark brown	6″
	Gravel	

Section M66. Previously described.

Section M83. 0.1 mi. S of Center Sec. 21, T17N, R2E. Taken in cleared area on left bank of Matanuska River bluff a short distance W. of power line.

Unit		Thickness
9	Silt, light brown, some roots	5″
8	Silt, light gray, some yellowish-brown mottling	2″
7	Silt, light brown	7″
6	Silt, light gray with yellowish-brown mottling	4″
5	Ash, yellowish-white, discontinuous layer	4″
4	Silt, similar to unit 6	4″
3	Silt, medium reddish-brown with some gray mottling	1″
2	Ash, yellowish-white, discontinuous, disturbed	0.5″
1	Silt, similar to unit 3, but with pebbles in lower 4 inches	1′0.5″

Section M69. 0.15 mi. N of the SE corner of Sec. 20, T18N, R2E. It is on a high west bluff overlooking the Matanuska River. M69 is the thickest and sandiest section measured. Above the section is a sand dune that is several feet thick at this point. Pictures of this section and the superimposed sand dune are shown in figures 9 and 10.

Unit		Thickness
18	Sand, medium brown, poorly sorted, beds are lenticular and dip in various directions	23′0″
17	Silt, highly organic, contains partially decomposed wood	1′0″
16	Sand, similar to unit 18	9′9″
15	Ash, pinkish-white	1″
14	Sand, medium textured, medium grayish-brown	1′7″
13	Sand, similar to unit 14 only coarser	4′9″
12	Sandy silt, fine, mottled gray and brown	1′2″
11	Sand, similar to unit 12 only coarser	2′4″
10	Sandy silt, similar to unit 12, contains two fairly continuous ½ inch ash layers 2″ apart	6′2″
9	Sand, medium textured, mottled gray and brown	2′4″
8	Sandy silt, fine, dark grayish-brown	6″
7	Sand, similar to unit 8 only coarser	1′9″
6	Sandy silt, fine, contains two 0.5-inch pinkish-white ash layers. They are continuous and 2″ apart	3″
5	Sand, medium textured	8″
4	Silty sand	4″
3	Sand, medium textured	1′2″
2	Sandy silt, fine	6″
1	Sand, medium textured	3′5″
	Gravel	

Particle Size

Mechanical analyses were performed on all soil samples returned to the Engineering Experiment Station. The mechanical analysis procedure used is outlined by Davidson and Chu[4]. The AASHO standard (1949) and ASTM (1954) size classification was adopted, i. e., sand is 0.074 to 2.0 mm. diameter, silt is 0.005 to 0.074 mm. diameter, and clay is less than 0.005 mm. diameter.

Particle distribution. Particle-distribution curves are quite similar in form to those of the loess of Iowa. Particle-distribution curves for the M7, M13 and M66-5 samples, and the area which includes 75 percent of the particle size of the mid-depth samples, are shown in Figure 14. The 75 percent area was found by drawing histograms of the percentage range of the different particle sizes for the mid-

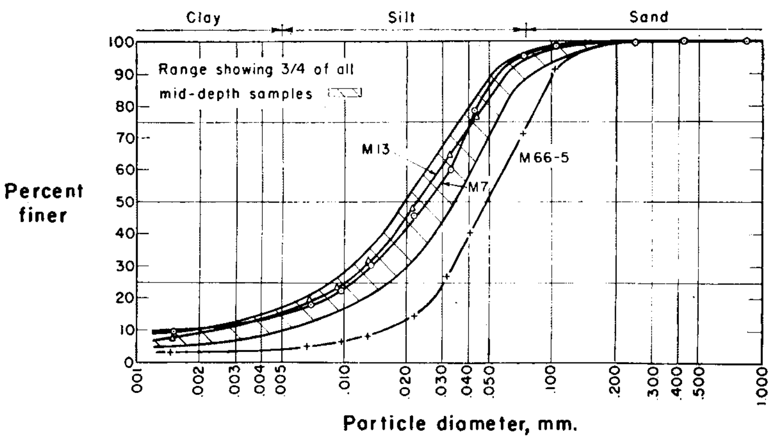

Figure 14. Particle size accumulation curves for the three large samples and the median 75 percent range for the various size grades of the mid-depth samples.

depth samples. The 75 percent range in the center of the histogram was then used to plot the curve.

Sand fraction. Variation in the sand percentage over the area of study is shown in the sand percentage contour map of the mid-depth samples, Figure 15. Comparison of this map with the isopachous map shows that sand percent generally parallels thickness, though several differences may be noted. In the northern part of the area, the higher iso-percentage lines extend farther west than the higher isopachous contours. Across Palmer Terrace, the sand percentage contours run diagonally northwest-southeast, whereas the isopachous lines have general north-south direction. Several small anomalies are also present in the sand percentage map. Most of these anomalies are present at or near the two large constrictions in the Matanuska River.

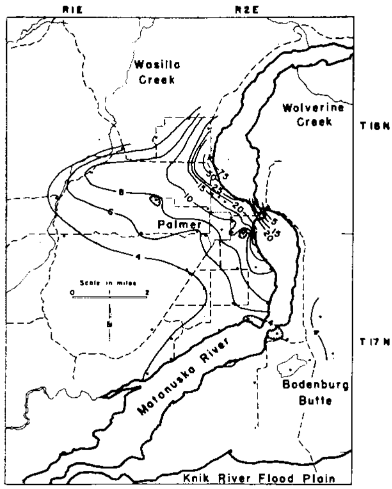

Figure 15. Sand percentage contour map of the mid-depth samples. Contour intervals 2, 5, and 25 percent.

The sand percentage and the clay percentage of the mid-depth samples, and the thickness of the silt along the five traverses are shown in Figure 16. The sand percentage is related to thickness on the river traverse and to a lesser degree on the north-south and northeast-southwest traverses. The particle-size and thickness correlations on the east-west and especially on the southeast-northwest traverses are poor. This last traverse runs almost parallel to the sand percentage lines crossing Palmer Terrace.

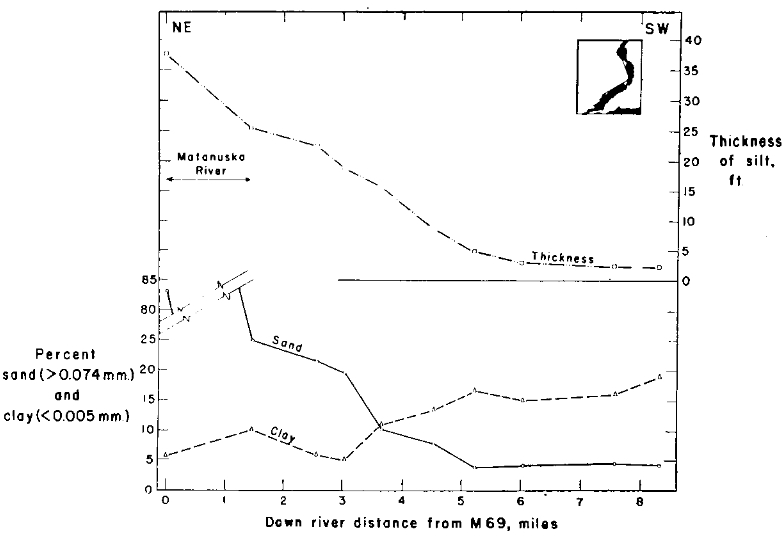

Figure 16a. Thickness and sand and clay percent variation along the river traverse.

Sand percentage variation with depth in the four depth sections is shown in Figure 17. This diagram indicates that the particle size in the silt is relatively uniform vertically except in the basal part of the sections. Some thin sand layers are present in the eastern part of the area in the basal silt.

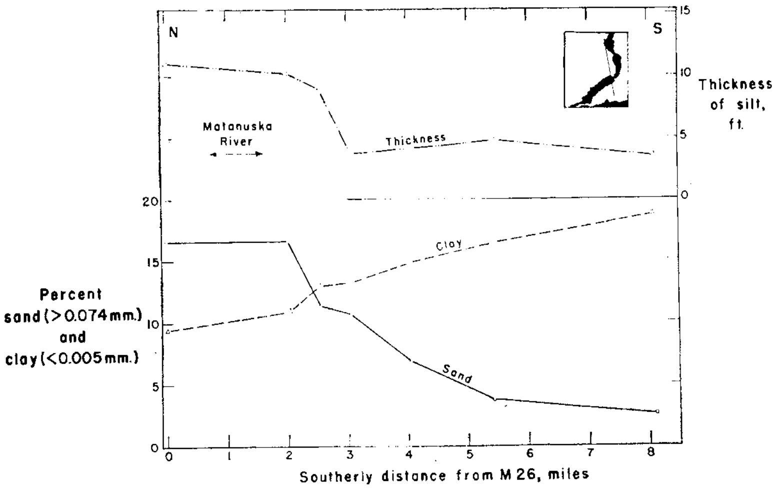

Figure 16b. Thickness and sand and clay percent variation along the north-south traverse.

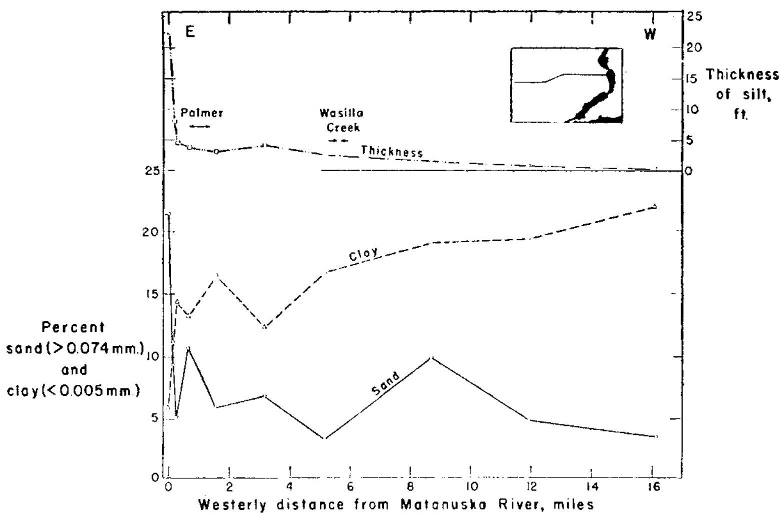

Figure 16c. Thickness and sand and clay percent variation along the east-west traverse.

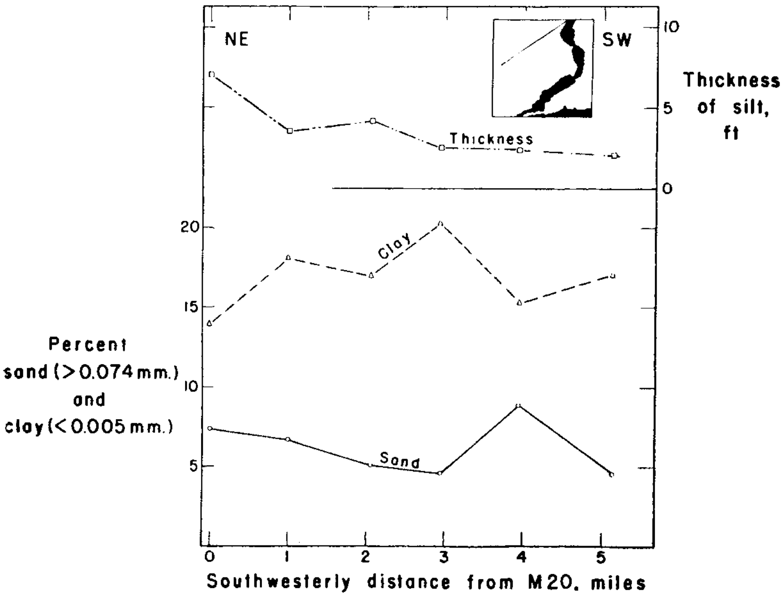

Figure 16d. Thickness and sand and clay percent variation along the northeast-southwest traverse.

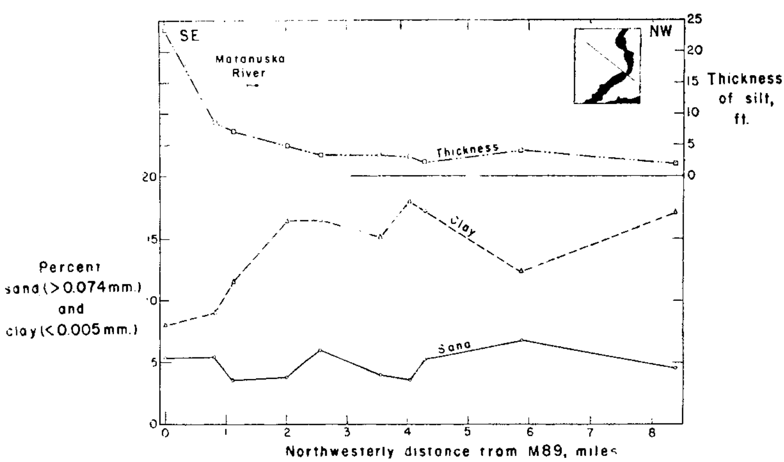

Figure 16e. Thickness and sand and clay percent variation along the southeast-northwest traverse.

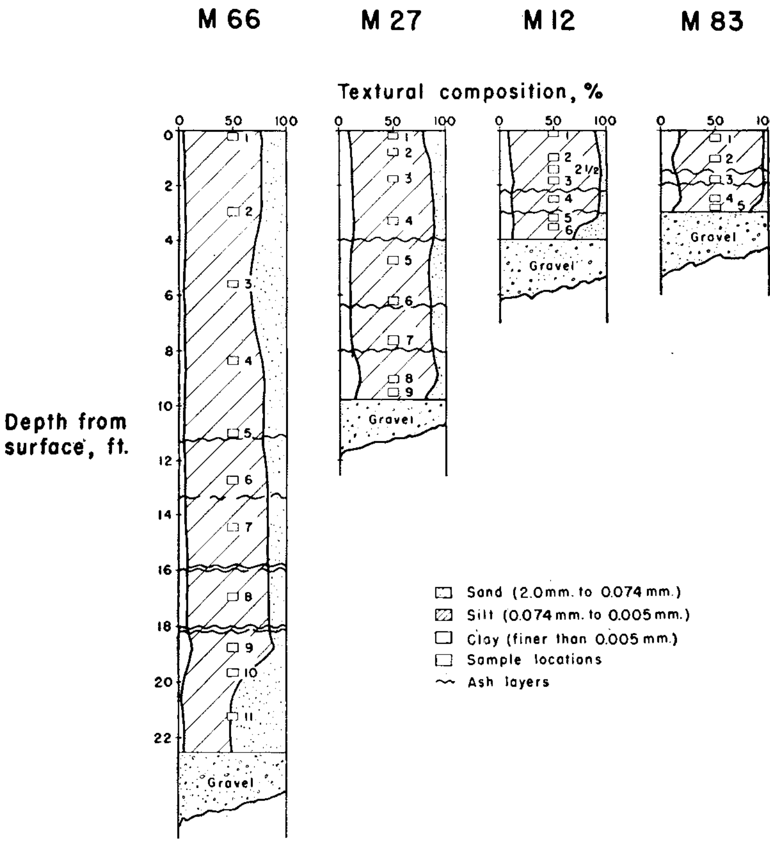

Figure 17. Particle size variation with depth in the four depth sections.

Examination of the section description of M69 shows layers of alternating fine and medium sand in the lower part of the section. These alternating layers are not discernable in the finer material to the west. However, alternating silt and sandy silt layers are present in sections along the river south of M69.

The sand percentage averages 7.90 for the 52 mid-depth samples. Figure 18 is a histogram of the sand percentage variation in all mid-depth samples. Most of the mid-depth samples are seen to have a low sand percentage. The histogram is bimodal with a secondary mode at 14 to 20 percent.

Clay fraction. The clay percentage is generally inversely related to thickness and to sand percentage. The clay percentage contour map of all mid-depth samples is shown in figure 19. The clay contours more nearly parallel the isopachous lines across Palmer Terrace than the sand percentage lines.

With an exception near the northern constriction in the Matanuska River, there is a wide separation between the 14 and 16 clay percent contours. The clay percent increases sharply in a west direction to 14 percent, then levels off to 16 percent and then rises sharply again. This "plateau" extends to Wasilla Creek in the northern part of the area, becomes much thinner at the northern river constriction, and follows the scarp above Palmer Terrace. This may indicate similar depositional conditions for fine material over a broad area on the flat topography of the northern and southern areas.

As in the sand percentage map, both constrictions in the Matanuska River are marked by anomalies. Contours return from

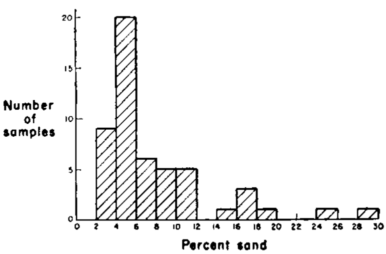

Figure 18. Sand percentage histogram of mid-depth samples.

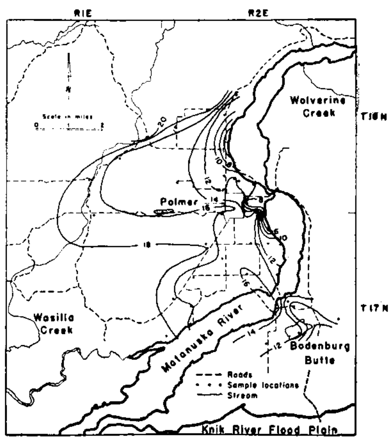

Figure 19. Clay percentage contour map of mid-depth samples. Contour interval two percent.

the west to the northern constriction, forming a lobate pattern. There is a low-sand, high-clay area at the southern constriction.

The traverses of figure 16 also show the inverse property of the clay percentage to the sand percentage and thickness. A good correlation is shown on the north-south traverse, and mediocre correlations are present on the down river and east-west traverses. Poor correlations are present on the southeast-northwest and northeast-southwest traverses.

Like the sand percentage, there is slight variation of clay with depth except in the basal portion, as indicated by figure 17. With the exception of M12, the clay percentage decreases with the increase in sand percentage in the lower part of the sections.

The origin of the basal sandy silt is an interesting problem. Trainer[2], pp. 76-7, has found a few sections underlain by till where he attributes pebbles and cobbles in the basal silt to be derived from the till by the action of frost. He does not believe colluvial movements could account for a great deal of mixing, but concludes that mixing by falling trees is the best explanation for the presence of the pebbles and cobbles.

The pebbles and cobbles are locally present on slopes in the basal silt, while on flats the basal material more nearly resembles a sandy silt. Only in one instance did it contain particles larger than 2.0 mm., and then only in a low percentage. The decrease in clay content in the sandy zone possibly cannot be ascribed to dilution of the fines by increase in sand. Further study may make clearer the origin of this material.

Clay percentages averaged 14.06 for mid-depth samples, or twice the average sand percent for the same samples. The clay percentage histogram, figure 20, shows that the frequency curve is skewed toward the higher clay percentages.

Silt fraction. The inverse relationship of the clay and sand percentages has been noted along the various traverses and in the depth sections. That the silt fraction is relatively constant and the sand and clay vary at the expense of each other is further illustrated in fiugre 21, a graph of the sand and clay percentages.

Sorting. The contour map of the sorting coefficients of the mid-depth samples is presented in figure 22. The best sorted silt is in a circular band surrounding an area of poor sorting south of Palmer. With the exception of one location, the silt along the right bank of the river is well sorted, as is the silt between Palmer and Wasilla Creek. The silt becomes poorer sorted north and west of Bodenburg Butte toward the Matanuska River, and poor sorting is also present in the vicinity of Palmer, in the north part of Palmer Terrace, and in a band trending northeast-southwest near Wasilla Creek.

The sorting shows a general relationship to particle size (see figure 23). In the major part of the samples, sorting is better with the larger median size. Several of the sandy basal samples do not fit this curve and are poorer sorted. Sorting generally becomes poorer with depth. Further study of the sorting in the basal silt may aid in determining the origin of this sandy material.

The sorting coefficient of the mid-depth samples averages 1.98. It is, therefore, fairly well-sorted material.

Special samples. The properties of four special samples are shown in the table 1. The samples were collected in a box 20 feet above ground, from leaves beneath this box, from stationary silt deposits on the bare Knik River floodplain and from sand drifts on the same flood-plain. The samples from the box and

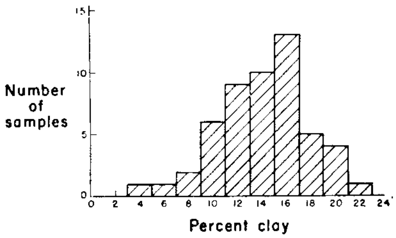

Figure 20. Clay percentage histogram of mid-depth samples.

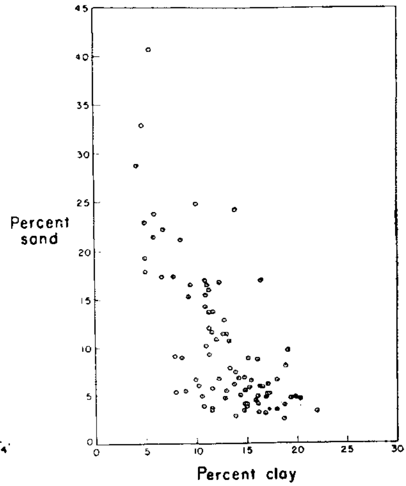

Figure 21. Graph of sand and clay percentage.

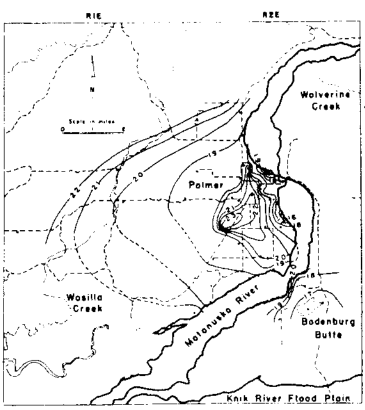

Figure 22. Sorting coefficient contour map of mid-depth samples.

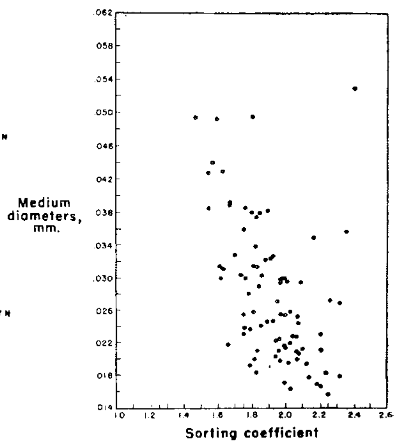

Figure 23. Graph of sorting coefficient and median diameter.

leaves were obtained in the vegetation immediately adjacent to the unforested portion of the floodplain.

Summary. The particle-size relationships, as noted above, fall generally into a pattern. Particle-size variations with depth are small except in the basal portions. The contour maps and traverses show the general tendency for the sand percentage to decrease with decreasing thickness and the clay percentage to increase with decreasing thickness.

These relationships hold best for the down river and north-south traverses, less well for the east-west and northeast- southwest traverses, and rather poorly on the southeast-northwest traverse. The contour maps indicate that a better correlation in the northeast-southwest direction would be obtained if this traverse was taken farther south.

Table 1.

Properties of the Four Special Samples

Sample	Textural Classification	Percent Sand	Percent Clay	Median Diameter (mm)	Sorting Coefficient
Aeolian silt trapped in box 20 feet above ground	Silty loam	5.54	8.3	0.0315	1.62
Aeolian silt deposited on leaves on the ground	Silty loam	11.15	7.6	0.0385	1.55
Alluvial silt from flood-plain	Silty clay	25.25	20.0	0.0350	3.04
Blowing sand	Sand	95.03	1.4	0.428	1.55
Silt deposit mid-depth averages		7.9	14.06	0.025	1.98

Engineering Properties

The engineering properties of the three representative samples are summarized in table 2.

The average plasticity index for the mid-depth samples is 4.46, and is 3.59 for all Matanuska Valley samples. Detailed clay mineral studies may furnish additional information on the low plasticity. That these indices are relatively low as compared with those of loess materials of Iowa is due in part to the smaller amounts of clay present in the Matanuska Valley silt.

Table 3 summarizes the plasticity properties and classification of the silt with depth. It will be noted that at a depth of about two feet, there is a slight increase in plasticity in sections M12, M27, and M83. Particle-size variations with depth (see figure 17) show no significant increase in clay at two feet. This increase in plasticity is therefore probably due to the concentration of humus rather than to a zone of clay accumulation due to soil-forming processes. Since section M66 is composed of sandier silt, it is less plastic.

The Bureau of Public Roads classifications of the samples shown in table 3 indicates the homogeneous character of the Matanuska

Table 2.
Engineering Properties of Three Representative Matanuska Valley Silt Samples

Engineering Properties		Sample No. M7	M13	M66-5	AASHO Test Method
Liquid Limit, %		32.7	36.5	26.0	T89-49
Plastic Limit, %		27.1	31.3	24.0	T90-49
Plasticity Index, %		5.6	5.2	2.0	T91-49
BPR Engineering Classification		A-4(8)	A-4(8)	A-4(7)	M145-49
Specific Gravity, 25°C.		2.67	2.65	2.77	T100-38
Standard Proctor Density	Max. Dry Density, lbs/cu. ft.	94.0	91.6	102.9	T99-49
	Optimum Moisture Content, %	23.6	25.0	18.4	T99-49

Valley silt. Of the 91 samples taken, 77 classified as A-4(8). In the textural classification, 84 of the 91 samples are classified as silty loam. The A-4 soil group includes non-plastic or moderately plastic silty soil.

Preliminary investigation has begun on the California Bearing Ratio test of the large samples. Early work indicates a wide variation between ratios determined for the fresh silt and the recompacted material. No such relationship was found for the loess materials in Iowa. Further study may reveal the reasons for this variation.

The average sorting coefficient for the mid-depth samples is 1.98. The relatively high sorting of the silt indicates that the material has only fair gradation. The particle-distribution curves for the three representative samples and for the median 75 percent of the mid-depth samples are shown in figure 14.

In-place density and field moisture content tests were performed at depth intervals at the four depth sections. The resulting data are shown in figure 24. All four sections show an inverse relationship between the field moisture and in-place density. A similar variation has been found in the Iowa loess[5].

In three of the sections, the density increases to a certain depth and becomes stable. The decrease in moisture content suggests that this density increase is not due to accumulation of fine material by soil-forming processes. Accumulation of fines should result in an increase in natural moisture content, as shown by Lyon, Handy, and Davidson[6]. Cultivation produced low densities near the surface in section M83 and possibly in M27. Decrease in porosity and compaction of the material by the superimposed silt may be the best explanation for the density increase in section M66. This characteristic was also found in the loess in Iowa[7].

All four sections have an increase in density near their bases. This

Table 3.

Property Variations with Depth for the Four Matanuska Valley Depth Sections

Sample No.	Section Location	Depth of Sampling	Plastic Limit	Liquid Limit	Plasticity Index	BPR Classification† Engineering
M12-1		0-4″	28.4	30.8	2.4	A-4(8)
M12-2		10″-1′2″	21.4	25.5	4.1	A-4(8)
M12-2½		1′3″-1′7″	22.3	25.6	3.3	A-4(8)
M12-3	0.1 mi. E, NW corner	1′8″-2′	21.4	23.3	1.9	A-4(8)
M12-4	of Sec. 6, T17N, R2E	2′4″-2′8″	20.4	23.4	3.0	A-4(8)
M12-5		3′-3′4″	22.4	23.6	1.2	A-4(8)
M12-6		3′4″-3′8″	19.9	22.7	2.8	A-4(8)
M27-1		0-4″	44.2	46.6	2.4	A-5(9)
M27-2		8″-1′	32.6	36.0	3.4	A-4(8)
M27-3		1′8″-2′	30.5	35.1	4.6	A-4(8)
M27-4		3′2″-3′6″	26.0	28.0	2.0	A-4(8)
M27-5	0.1 mi. N, SW corner	4′8″-5′	23.2	25.5	2.3	A-4(8)
M27-6	of Sec. 28, T18N, R2E	6′1″-6′5″	24.4	26.6	2.2	A-4(8)
M27-7		7′6″-7′10″	24.1	27.1	3.0	A-4(8)
M27-8		8′11″-9′3″	23.2	27.4	4.2	A-4(8)
M27-9		9′3″-9′9″	23.8	26.2	2.4	A-4(8)

Table 3 Con't.

M66-1		0-4″	33.8	35.8	2.0	A-4(8)
M66-2		2′8″-3′	27.6	29.2	1.6	A-4(8)
M66-3		5′5″-5′9″	25.35	25.65	0.3	A-4(6)
M66-4		8′2″-8′6″	26.3	27.3	1.0	A-4(8)
M66-5		10′10″-11′2″	24.0	26.0	2.0	A-4(7)
M66-6	NW¼ Sec. 3, T17N, R2E	12′7″-12′11″	25.5	27.4	1.9	A-4(8)
M66-7		14′3″-14′7″	25.1	28.0	2.9	A-4(8)
M66-8		16′10″-17′2″	24.25	26.35	2.1	A-4(8)
M66-9		18′7″-18′11″	26.3	28.2	1.9	A-4(8)
M66-10		19′8″-20′	N.P.*	......	....	A-4(5)
M66-11		20′-20′7″	N.P.*	......	....	A-4(3)†
M83-1		0-4″	34.7	40.9	6.2	A-5(8)
M83-2	0.1 mi. S. center	10″-1′2″	32.3	33.8	1.5	A-4(8)
M83-3	of Sec. 21, T17N, R2E	1′6″-1′10″	25.6	29.3	3.7	A-4(8)
M83-4		2′4″-2′8″	28.25	30.25	2.0	A-4(8)
M83-5		2′8″-3′	24.3	25.0	0.7	A-4(8)

*N.P.=Non Plastic.
†BPR textural classification of all samples except M66-11 is silty loam. Classification of M66-11 is sandy loam.

is due to the increase in sand in this part of the section. The increase in grain size and resulting increase in permeability accounts for the sharp decrease in moisture content.

Specific gravities of the silt are higher than the Iowa loess and showed a general relationship to particle size. Twenty-three samples, many of which were near the Matanuska River, had an average specific gravity of 2.73. Generally, the specific gravity was directly proportional to sand percentage. The higher specific gravities are therefore present in the northeast part of the area with a gradual decrease down river. A short distance west of the river, there is a rapid decline in the specific gravity. This is characteristic of deposition by a natural agency transporting material from a local source.

The presence of organic matter may pose a special soil stabilization problem. Humus, as well as fine roots, is present in all sections and generally throughout the entire depth. The long cold winters and cool wet summers give the organic matter little opportunity to decompose. The permeability of the silt enables the roots to penetrate and humus to eluviate to a considerable depth. Organic matter problems should be fully investigated in any stabilization procedure with these Alaskan materials.

Thermal Properties

Differential thermal analysis apparatus was used to study the thermal properties of the whole silt. Studies of minus two micron clay fraction have not been completed. This will include x-ray analysis as well as differential thermal curves. Thermal curves for whole silt of samples M7, M13, M66-5, and M29 are shown in figure 25. These samples are believed to be fairly representative of Matanuska Valley silt. The first three curves shown were run in an atmosphere of free nitrogen to eliminate the effect of organic matter. The curve of M29, which was run without nitrogen, shows the masking effect organic matter has on reactions between 100° and 500°C.

The best method of differentiating between montmorillonite and illite clay minerals from thermal curves is by the size of the first endothermic peak at 100°C., which indicates a loss of hygroscopic water. Montmorillonite, which has a greater water-holding capacity, will produce a larger water loss curve than illite. The second endothermic peak shows the beginning of the destruction of the clay lattice and in montmorillonite occurs usually at about 700°C. In illite it ordinarily occurs between 500° and 600°C., but there is overlapping between the two types of minerals.

On this basis, the curves suggest that both illite and montmorillonite may be present in M7 and M13. Sample M66-5 appears to contain only illite. The pronounced peak at about 575° in

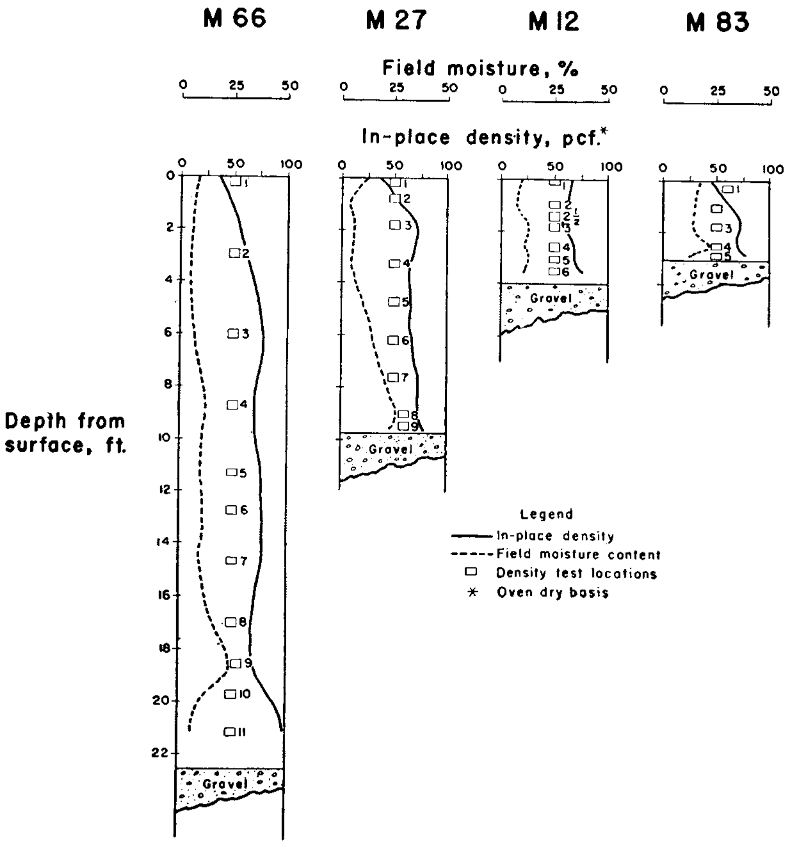

Figure 24. In-place density and field moisture content variation with depth in the four depth sections.

M66-5 indicates the larger amount of quartz present in this sample than in the other two.

Big Delta

During the summer of 1954, the field party spent a week at the Big Delta area, making a reconnaissance that would facilitate studies at a later date. The 1955 field party plans to make a detailed study of the silts in this area.

The location of the Big Delta area is shown in figure 1. The area of study in 1954 was that east of the Delta River valley as far north as the Tanana River, and the Big Delta airport marked the southern boundary. The Delta River is a braided stream, similar to the Matanuska River, and deposits from valley glaciers are prominent on its floodplain.

Sampling

The sampling procedure at Big Delta was similar to that of the

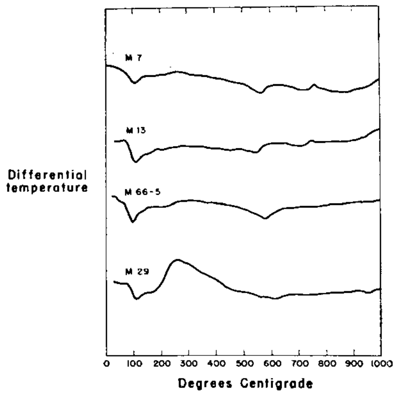

Figure 25. Thermal curves of four selected whole silt samples.

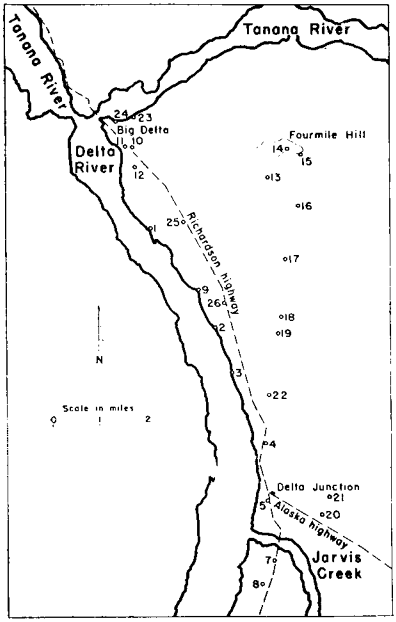

Figure 26. Map of the Big Delta area of study showing locations of sections.

Matanuska Valley. Altogether 40 soil samples were taken; nine of these were mid-depth samples. Two were silt samples from the Delta River and Jarvis Creek stream beds. One sample of fossil was also taken. Sample D25-2 was considered representative of the silts as Big Delta and therefore a large sample was removed for engineering tests. Since the silt of location D-1 is typical of the silts along the Delta River, this section was sampled at regular depth intervals; and in-place density and field moisture tests were made. The locations of the sections and samples are shown in figure 26.

Thickness and Occurence

The silts occur as a surficial deposit covering the older tpography. Generally they have been deposited on sands and gravels, but they are also present on Fourmile Hill, a bedrock erosional remnant.

The silt is very thin in the southern extremity of the area, measuring less than two feet thick. There is a very rapid increase in thickness north of Delta Junction. Here the silt is thick (approximately 20 feet) along the riverbank. The silt exposure is shown in figure 27. The thickness along the river gradually decreases north of D3, and there is a rapid thickness decrease eastward from the river. Figure 28 shows a thin layer of silt covering a hill one-half mile east of the river.

Figure 27. Silt exposure along Delta River.

Figure 28. Silt exposure ½ mile east of the Delta River.

Field Description

The most obvious characteristic of the Big Delta silts is the presence of muscovite, and most samples contained abundant amounts. The source of much of this material is probably the Delta River, which drains large areas of gneissic and schistose rocks.

The sections are made up of different colored horizontal bands; shades of brown, red, gray and yellow predominate. The sections along the river are commonly composed of alternating beds of sandy and silty material, and black organic zones may be present.

Ferric iron concretions are present in many of the silt sections.

Kellog and Nygaard[3] have found subarctic brown forest soils the dominant great soil group on the well-drained areas near Big Delta. Half-bog soils are present where drainage is more restricted.

Permafrost is present where moss furnishes a good insulation.

The sections D1, D25 and D17 are considered representative of silt; on the river bank, a short distance east of the river, and on the flat several miles east of the river, respectively.

Section D1. This section was described on the east bank of Delta River, 1.5 mi. S. of Big Delta.

Unit		Thickness
9	Sandy silt, light gray, very dry, micaceous, contains partially decomposed wood layers and many roots	2′
8	Silt, light yellowish-brown, micaceous, roots in upper 1½′, contains partially decomposed wood layers	3′
7	Silt, light reddish-brown, micaceous	1′2″
6	Silt, light yellowish-brown with light gray mottles, micaceous, separated from the above layer by a thin wood zone	4′4″
5	Silt, medium grayish-brown, micaceous, contains charcoal	2″
4	Silt, reddish-brown with gray mottles, micaceous, contains horizontal organic separations	3′10″
3	Silt, medium gray with some yellowish-brown mottles, micaceous	1′
2	Silt, reddish-brown with less red toward bottom, micaceous	1′2″
1	Silt, medium brown, micaceous, dense, contains faint black streaks and some bluish-gray mottling in the top 1½′, separated from the next above layer by ¼-½″ black carbonaceous band	2′4″
	Gravel, imbricate	

Section D25. This section was taken at a roadcut on the west side of Richardson Highway, 0.43 mi. N. of Cache Inn and 0.9 mi. S. of curve.

Unit		Thickness
6	Silt, dark brown, micaceous	6″
5	Silt, medium grayish-brown, micaceous	1′
4	Silt, reddish-brown at top, gray at the bottom, micaceous, contains horizontal color bands of black and yellowish-brown	2′11″
3	Silt, bright yellowish-brown, micaceous, slightly stratified	1′
2	Sand, medium textured, micaceous	1′
1	Silt, light brown and silver gray, micaceous, stratified	2′
	Gravel	

Section D17. This section was augured along a trail 2.3 mi. S. of Fourmile Hill.

Unit		Thickness
3	Silty root mat	2″
2	Silt, medium brown, micaceous	8″
1	Silt, light yellowish-brown with gray mottled, micaceous, slight layered structure	2′2″
	Gravel	

Particle Size

Mechanical analyses were run an all soil samples. The particle-distribution curve for the representative sample D25-2 and for the median 75 percent of all samples are shown in figure 29. The procedure was the same as outlined by Davidson and Chu[4] with one exception. Air dispersion of silt samples at 25 pounds pressure was found to break the mica particles, resulting in a decreased sand percentage. Tests indicated that a pressure of 10 lbs. produced only small breakage. This pressure was, therefore, used for all Big Delta and Fairbanks samples.

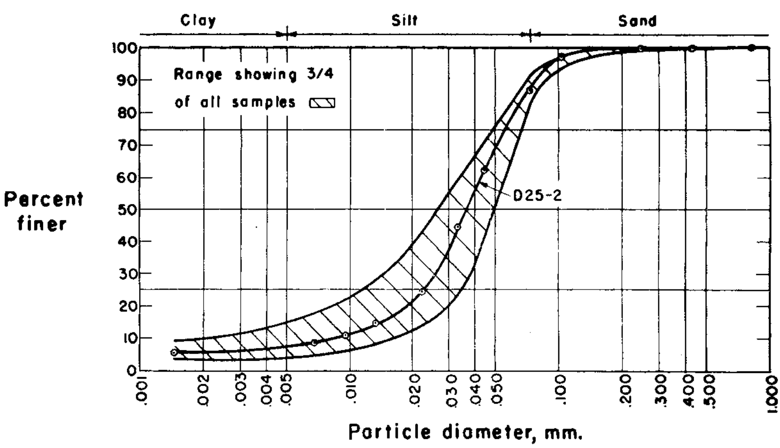

Figure 29. Particle size distribution curve for large sample D25-2 and the median 75 percent range for the various size grades of all Big Delta samples.

Figure 29 indicates that the 75 percent range is greater in the silt than in the sand and clay ranges. This may be due to greater breakdown of the muscovite in this range than in the larger size grades.

As indicated in figure 30a, the upper part of the silt contains more sand in section D1. This was the only section sampled at intervals with depth. Further study may substantiate this property for

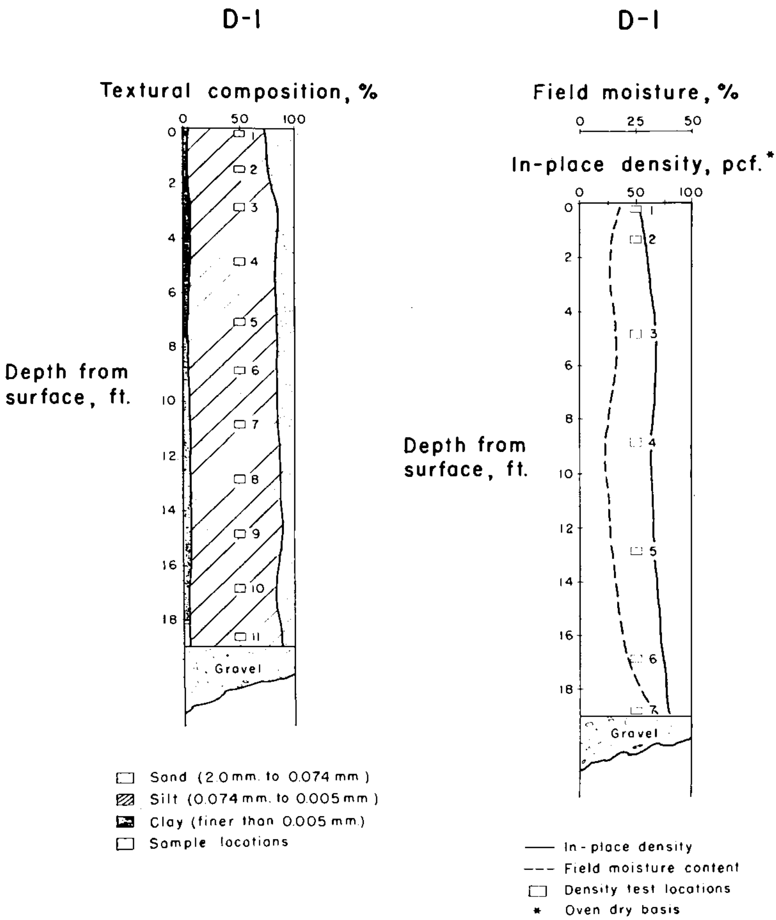

Figure 30. Property variation with depth at section D1. At left, textural composition; at right, in-place density and field moisture content.

the entire area.

The sand percentage for all Big Delta samples averages 14.1; the clay percentage (less than 0.005 mm.) averages 8.91. The materials taken from the Delta River and Jarvis Creek stream beds are more silty. The Delta River silt contained 6.03 percent sand and 3.9 percent clay. The Jarvis Creek silt contained 8.89 percent sand and 9.0 percent clay. Much of the sand-sized particles were in the form of muscovite.

Engineering Properties

Engineering properties tests for the Big Delta samples have not been completed. Big Delta and Fairbanks silts may pose special soil stabilization problems, since much of the sand fraction is composed of mica. This material may react differently under compaction than silts composed of hard mineral particles. Additional study may reveal the best methods of stabilizing these micaceous materials. As noted in the Matanuska Valley section, organic matter may also present another soil stabilization problem.

The in-place density and field moisture content with depth is shown in figure 30b. Density increases slightly with depth, and may be the result of compaction by the weight of the overlying material. The increase in moisture content (as shown in figure 30a) cannot be attributed to an increase in the fine material.

The results of the engineering tests performed on the representative sample, D25-2, are shown in table 4.

Table 4.
Engineering Properties of Sample D25-2

Engineering Properties		Sample D25-2	AASHO Test Method
Liquid Limit, %		33.2	T89-49
Plastic Limit, %		31.4	T90-49
Plasticity Index, %		1.8	T91-49
BPR Engineering Classification		A-4 (8)	M145-49
Specific Gravity, 25°C.		2.73	T100-38
Standard Proctor Density	Max. Dry Density lbs/cu. ft.	94.3	T99-49
	At Optimum Moisture Content, %	22.2	T49-99

The California Bearing Ratio studies have not been completed on sample D25-2. Preliminary work showed variations similar to those of the Matanuska Valley samples. These will be studied further.

Thermal Properties

Differential thermal analysis and x-ray tests have not been completed on the minus two micron fraction of the silts. Figure 31 shows the thermal curves produced from whole samples of D25-2 and D5. D25-2 was run in the presence of nitrogen, while D5, which contained only small amounts of organic matter, was not.

The endothermic reaction between 500 and 600°C. indicates that illite may be present in sample D25-2. The endothermic drift after 400°C. is attributed to the presence of muscovite. This drift is also shown in the curve produced by D5. The exothermic reaction at 75°C. also is due to muscovite. This sample contained 44 percent sand, including much muscovite. The small exothermic peak at about 575°C. is a quartz reaction.

Fairbanks

The location of the Fairbanks area is shown in figure 1. The field party of 1954 spent several days in reconnaissance of the area.

Study in the Fairbanks area was concerned with silts deposited on the uplands near the city of Fairbanks. These upland hills rise immediately north of the Tanana River. South of the river is a broad alluvial plain. This plain is shown in figure 33.

Sampling

The sampling procedure at Fairbanks was similar to that of the Matanuska Valley and Big Delta areas. Twelve sections were studied, and a total of 28 soil samples were taken, two of which were mid-depth samples. At location F8 near Ester Creek, hereafter called the Ester Island section, 18 samples were taken for later detailed study. Sample F10 was taken in large enough quantities to perform engineering properties tests.

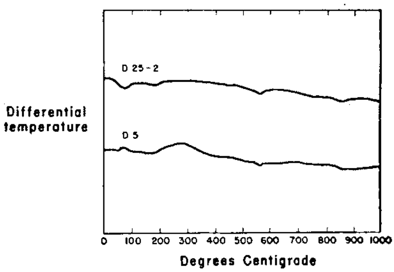

Figure 31. Thermal curves of two selected Big Delta whole silt samples.

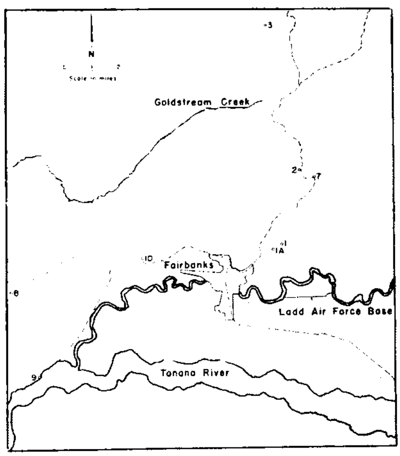

Figure 32. Locations of Fairbanks samples and sections. Sections F4, F5, and F6 are located north of this map.

Augering was handicapped in many places by the presence of permafrost.

The section locations are shown in figure 32.

Occurrence and Thickness

The silts in the Fairbanks region have been deposited on the hills north and west of the city of Fairbanks. They occur as a surficial deposit mantling the hills and valleys.

The silts have a wide range in thickness and are generally thicker on the lower slopes and in the valleys and thinner on the upper slopes and tops of the hills. Pèwè[8] has found the silt to be as much as 180 feet thick. This was near the Ester Island section.

Pèwè states that generally the upland silt is thickest near the Tanana River and decreases in thickness northward.

Field Description

The Fairbanks silts are similar to those of the Big Delta area in that they are micaceous, although muscovite in the Fairbanks silt is generally finer grained.

Ash layers are present in the Fairbanks silts. Figure 36a shows four layers at the Ester Island section. Pèwè reports the presence of buried soil horizons.

Permafrost was found in many of the sections. A black highly organic muck is found associated with the silt, generally near the valley bottoms. This material has an acrid odor and is often frozen, while material above and below it is unfrozen. Pèwè believes the muck to be silt transported from higher elevations by rill-wash, creep, and stream action. During the downslope action, the material has incorporated large amounts of organic matter.

Downslope movement is active in the area. Distortion of the material indicates some of the material present in the lowlands has been retransported from higher elevations by creep.

As was true of the Big Delta and Matanuska Valley areas, iron concretions less than two mm. in diameter are abundant.

The Ester Island section (F8) is an old placer gold mining pit. Oxidation is occurring at the present surface of the silt and down recently formed cleavage planes. The latter show diffusion banding. Figure 34 shows the sample site of the Ester Island section.

Figure 33. Tanana River and plain looking [illegible]

Figure 34. Ester Island sample site.

Ester Island Section. This section is located 0.2 mi. S. of the center of Sec. 8, T1S, R2W.

Unit		Thickness
20	Silty root mat, brown	6″
19	Silt, light gray and light orange alternating in 2 to 4″ layers, horizontal platy structure	8′
18	Silt, medium gray, random ferric iron spots and streaks	11′6″
17	Silt, similar to unit 18 but with sand lenses	0.5″
16	Sand, gray, fine continuous layer	1½″
15	Silt, similar to unit 18, containing ¼″ continuous white ash layer 6″ from bottom	4′6″
14	Silt, reddish-brown and gray, disturbed, contains wood and charcoal	3′
13	Silt, medium gray, with ferric iron spots	8′6″
12	Silt, interlayered reddish-brown and gray, contains ¼″ discontinuous sub-horizontal reddish-brown streaks	2′
11	Silt, medium yellowish-brown with irregular contacts above and below	4′
10	Silt, medium gray, contains ferric iron streaks along slippage planes, exhibits vertical flakiness	13′
9	Silt, medium brown, with organic spots	1′
8	Silt, bright yellowish-brown	1′
7	Silt, medium yellowish-brown, slightly stratified, contains 0 to 1″ pink ash lenses in upper part	1′6″
6	Silt, medium grayish-brown, massive contains small black spots and whorls	1′6″
5	Silt, light brownish-yellow, exhibits very slight horizontal flakiness, contains horizontal black streaks that are especially abundant in upper 1′	6′
4	Silt, medium grayish-brown, massive, contains black streaks, contains a ½″ orange, discontinuous ash layer 6′ from bottom	10′
3	Silt, light gray, with yellowish-brown streaks, contains horizontal fault zone 8′ from top, contains light pink ash layer broken by faulting and located 7 ft. from bottom	12′
2	Silt, medium grayish-brown, massive, contains fault zone	18′
1	Silt, similar to unit 2, augered	9′
	Gravel	

Section F3 was described at the top of a hill north of Fairbanks, at an elevation of approximately 1550 ft. above sea level.

Section F3. This section was taken at the center of the N½ of the NW¼ of Sec. 26, T2N, R1W.

Units		Thickness
4	Moss cover. A_{00}	¼″
3	Silt surface layer, chocolate brown, contains abundant roots	6″
2	Silt, medium brown, small amount of medium gray mottling, moist, lower″ frozen	5′
1	Silt, light grayish brown, reddish-brown mottles, drier than unit 2	1′
	Bedrock	

Particle Size

Mechanical analyses were run on all Fairbanks soil samples by the method described by Davidson and Chu[4] which was modified to reduce breakage of mica particles. These tests indicated the Fairbanks silt is generally finer than the Big Delta. The 28 Fairbanks samples averaged 2.41 percent sand (2.0 to 0.074 mm.) and 11.54 percent clay (less than 0.0005 mm.) The particle-distribution curves for sample F10 and the median 75 percent of all samples is shown in figure 35.

Conclusions regarding particle size in this area must wait for further study, since the small number of samples taken in the short time this study was made may not be representative, and the 28 samples are heavily weighed by the 18 depth samples from the Ester Island section. These Ester Island samples averaged 2.19 percent sand and 11.8 percent clay.

Particle-size distribution with depth at the Ester Island section is shown in figure 35a. It will be noted that the texture is relatively uniform with depth.

One muck sample showed a somewhat higher clay content. This sample was taken from section F5. It showed 19.6 percent clay. Organic matter could have accounted for a higher hydrometer reading; but since organic matter has such a low specific gravity, very large amounts would be needed to produce this effect.

Engineering Properties

Engineering properties tests on the Fairbanks samples are only partially completed. Table 5 summarizes the engineering properties for the large sample F10. As in the Matanuska Valley and Big Delta large samples, the California Bearing Ratio test produced wide variations and is being studied further.

Table 5.
Engineering Properties of Sample F10

Engineering Properties		Sample F10	AASHO Test Method
Liquid Limit, %		24.7	T89-49
Plastic Limit, %		23.1	T90-49
Plasticity Index, %		1.6	T91-49
BPR Engineering Classification		A-4 (8)	T100-49
Specific Gravity, 25°C.		2.75	T100-38
Standard Proctor Density	Max. Dry Density, lbs/cu. ft.	104.2	T99-49
	Optimum Moisture Content, %	18.1	T99-49

Plasticity tests that have been completed indicate that the material is only moderately plastic for material with this amount of clay. The muck sample tested does not have abnormally high plasticity as compared with the other Fairbanks samples tested.

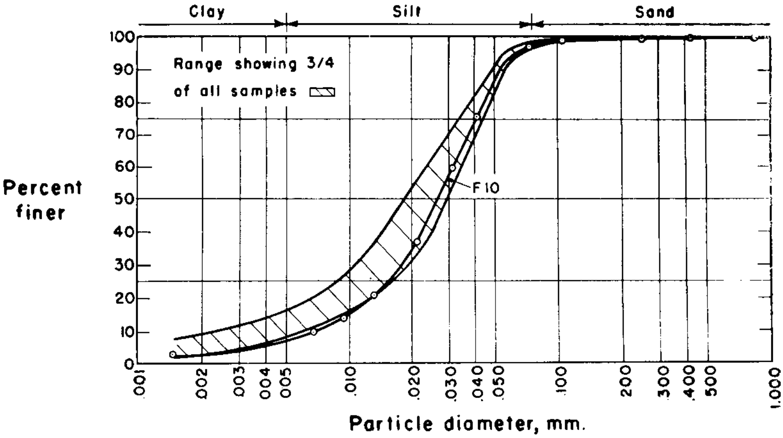

Figure 35. Particle distribution curves for large sample F10 and the median 75 percent of all samples.

The in-place and field moisture content with depth is shown in figure 36b. The slight increase in density with depth is probably due to increased compaction by the weight of the overlying material.

In addition to soil stabilization problems connected with compaction of highly micaceous soil and presence of large amounts of organic matter, the permafrost in the region presents added engineering problems. The permafrost layers form perched water tables as shown in the section description of F3.

Thermal Properties

As is true of the Matanuska Valley and Big Delta samples, the studies of the minus two micron fraction have not been completed. Differential thermal analysis curves for two whole samples, F10 and F8-7, are shown in figure 37.

The weak reactions produced by F10 are due to the small amount of clay present in the sample. The gentle endothermic reaction between 500 and 600°C. indicates that illite may be present, while the small nipple-like curve is due to quartz. The exothermic drift after 325°C. in sample F8-7 is due to the presence of muscovite, while the small endothermic reaction at about 575°C. is caused by quartz. That some clay mineral is present is suggested by the small water-of-hydration endothermic reaction at 100°, but this may be due to water held by finely divided muscovite.

Acknowledgements

The data collected and presented herein were obtained under contract Nonr 530(04), Geography Branch, Office of Naval Research, U. S. Navy. The field data and samples were collected in

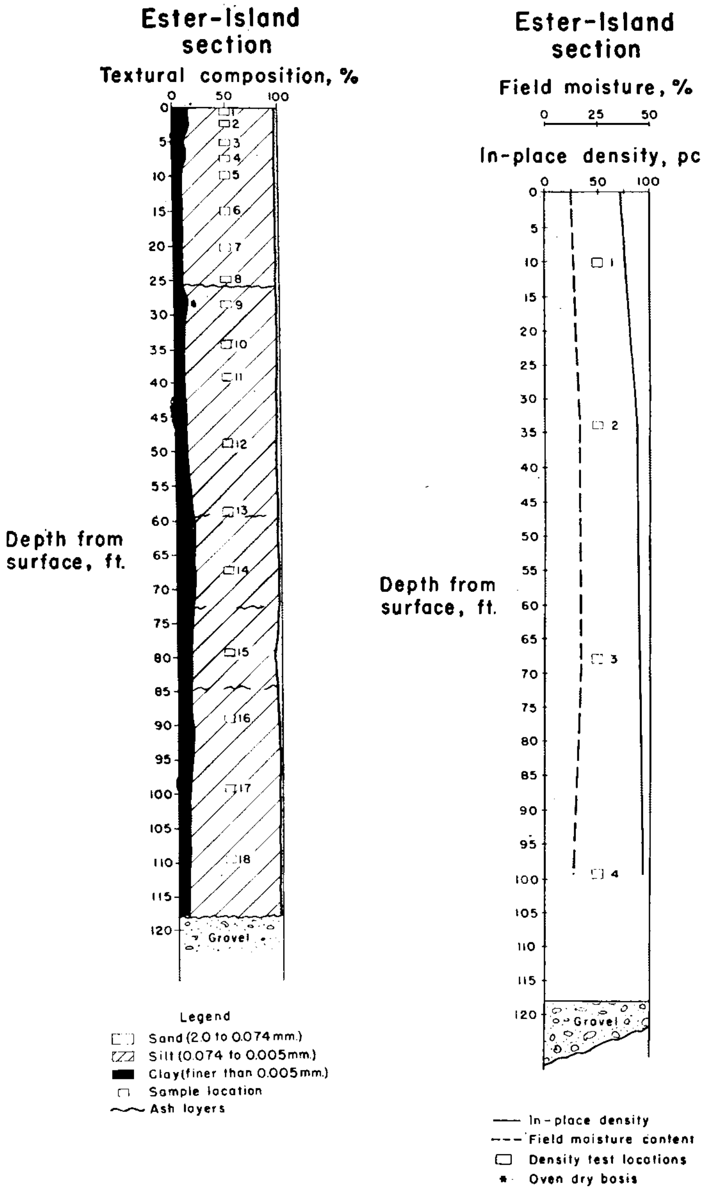

Figure 36. Property variation with depth at the Ester Island section. At left, textural composition; at right, in-place density and field moisture content.

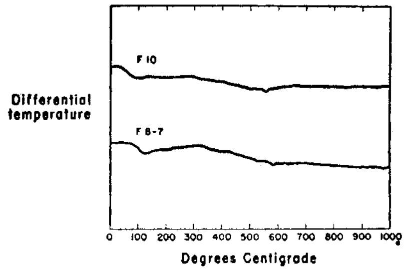

Figure 37. Thermal curves for two selected Fairbanks whole silt samples.

the summer of 1954 by a field party consisting of Dr. D. T. Davidson, of the Department of Civil Engineering, Dr. C. J. Roy, of the Department of Geology and Dr. R. L. Handy of the Iowa State College Engineering Experiment Station. Laboratory tests and collection of laboratory data was carried out by Mr. R. W. Stump, of the Engineering Experiment Station with the assistance of the members of the field party.

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