Glacial Drift Stratigraphy: New London-Spicer Area, Minnesota

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The area of New London and Spicer, Minnesota, like most of the state, was shaped by erosional and depositional events that occurred during the Pleistocene epoch. Glacier advances and retreats have left a complicated drift stratigraphy.

This investigation was undertaken in order to:

Identify the surficial and subsurface distribution of the different drift deposits;

To determine the thickness of these glacial deposits.

Previous studies span 100 years

The glacial deposits of western Minnesota were first mapped by W. Upham (Upham 1880, 1881, 1884, 1886). T. C. Chamberlin then studied the surface deposits by relating them to three different ice sheets (Chamberlin, 1883, 1894).

F. Leverett with the help of F.W. Sardeson drew up a map showing two drifts in southwestern Minnesota (Leverett and Sardeson, 1919). Later Leverett (1942) concluded all drift in Minnesota was from the Wisconsin period. Ruhe (1950) divided the Wisconsin period into four substages.

Schneider (1961) studied the late Wisconsin glaciation in central Minnesota. Wright (1962, 1964, 1965) worked out the Wadena glaciation of the Wisconsin period. C.L. Matsch and others (1972) recognized three different tills in southwestern Minnesota and possibly a fourth.

Study area in west central part of state

The New London and Spicer area is located in west central Minnesota about 100 miles west-northwest of the Twin Cities. It is in the northern half of Kandiyohi County. Larger cities in the area are Willmar, about 20 miles to the south; Alexandria, about 50 miles northwest; and St. Cloud, about 45 miles east-northeast.

The landscape is dominated by the Alexandria moraine. This moraine is made up of till and outwash. It is about 7-15 miles wide and forms a belt of hills that cross the area from the northwest to the southeast. The system of hills and kettles is dotted with many lakes, ponds, and marshes. The elevation of the moraine in this area reaches 1,375 feet above sea level at its highest point.

The area to the northeast of the moraine is a drift area of low rolling topography mainly made up of ground moraine, till, and outwash. Here the average elevation is about 1,250 feet. These areas are drained by the north and middle forks of the Crow River to the east.

To the southwest of the Alexandria moraine lies more glacial drift composed of ground moraine-till and outwash. The eastern half of this southwestern area is drained to the east by the south fork of the Crow River. The west half is drained to the southwest by Hawk Creek and Shakopee Creek. Elevation here averages about 1,110 feet.

No bedrock is exposed in the New London-Spicer area but well logs indicate two major rock types are found: (1) poorly defined Marine and Continental Cretaceous shales, clays and sandstones, and (2) metamorphic and igneous rocks of Precambrian age.

The bedrock surface below the glacial drift generally slopes to the southwest and south. Elevations of the bedrock are important because they show where preglacial lowlands and resistant ridges can be found. These lowlands and ridges influenced the direction of the ice lobes that went through the area.

The Cretaceous age rock seems to underlie the west and south halves of the area. Well logs show that this is shale and white sandstone. The shallowest bedrock is a shale in the Norway Lake area at an elevation of 1,075 feet (Thiel, 1944).

The eastern and northern portion is underlayed with metamorphic and igneous rock. In the Kandiyohi and Atwater vicinity the crystalline rocks occur at an elevation of approximately 800 feet. The deepest crystalline rock is in the Spicer area at about a 700 foot elevation (Thiel, 1944). This rock could be related to some outcrops in the Minnesota

Table 1. Pebble analysis data from the New London and Spicer area.*

Site No.	% Shale	% Carbonate	% Crystalline
1	1	57	42
2	1	59	40
3	0	58	42
4	0	58	42
5	0	57	43
6	1	55	44
7	2	58	40
8	0	59	41
9	1	53	46
10	0	59	41
11	17	43	40
12	8	42	40
13	7	56	37
14	5	47	48
15	19	48	33
16	10	56	34
17	16	52	32
18	3	48	49
19	1	54	45
20	6	59	35
21	6	59	35
21	13	48	39
22	1	50	49
23	4	56	40
24	7	55	38

*Collections taken from upper drift. Pebble size 4mm-12mm. Location of sites on Fig. 1.

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River valley to the south that are of the archean era. Some of the reported sands, sandstones, and clays from deep wells could be weathered Precambrian bedrock (Parham, 1970).

Stratigraphy--different drift units observed

Many of the rocks found in the glacial drift are quite different than those of the local bedrock. There are a great abundance of carbonate rocks, limestones and dolomites whose origin probably was southern Manitoba or northwestern Minnesota. Most locations also have shale present in the drift. Its source area was probably the Red River Valley and North Dakota. (Wright, 1965).

Glacial drift in the New London-Spicer area exhibits stratification that suggests different drift units. Surface exposures and the data from a deep well at the National Fish Hatchery near Spicer, shows at least 3 different glacial drifts and possibly more. These are the (1) Des Moines drift from the west and northwest; (2) Wadena drift from the north and northwest; and possibly (3) an earlier Superior drift from the northeast.

These were deposited during the early and late Wisconsin period of glaciation. They can be distinguished from each other by their lithology, stratigraphy and geographical distribution.

A similar and more detailed study of this type has been done in eastern South Dakota and southwestern Minnesota by Matsch and others (1972).

The younger Des Moines drift contains a light olive-brown calcareous clay loam, with pebbles of siliceous Cretaceous shale, carbonate and granitic rocks. Wadena drift is a yellow to yellow-brown calcareous loam, with mostly carbonate and granitic pebbles and lacking shale. The older Superior drift is pink to reddish-brown and sandy with pebbles and cobbles similar to rocks from the Lake Superior region to the northeast (Matsch and others, 1972).

Previous studies have used pebble analysis to distinguish one drift form another (Ruhe and Gould, 1954; Schneider, 1961; Wright, 1954, 1962; and Matsch, 1972). Surface drift pebble samples were separated into shale, carbonate, and crystalline rocks. From these samples, percentages of each three categories were calculated. Table 1 shows the data from each location, and Figure 1 shows the sample sites.

The surface pebble analysis data was then plotted and the percentage of shale gives some indication as to how much of the area is covered by the younger Des Moines drift.
It is evident that from the southwest to the northeast the shale content generally decreases. The lowering shale content could reflect progressive dilution from the center of the Des Moines lobe toward the margins as a result of differential subglacial erosion (Matsch, 1972). Shale is a very brittle rock and the farther and longer it is transported the more it will be weathered. Matsch (1972) had similar results in south western Minnesota. The shale percentages there were even higher because this area was nearer the center of the Des Moines lobe ice.

The shale data shows that the Des Moines ice probably crossed over most of the older Alexandria moraine except for maybe some isolated areas. The area just north of New London appears to be shale free and other small shale free areas probably exist in the moraine. Wright (1962) estimated that the Des Moines ice was very thick, 1000 feet or more, and advanced over the moraine to the east and northeast. A gravel pit north of the New London-Spicer area in Stearns County, T. 122 N., R. 34 W., contained shale fragments. This would indicate that the Des Moines ice did move over the moraine.

Older Wadena drift, which is shale free, underlies the entire

Table 2. Pebble analysis of well screenings from a National Fish Hatchery well in New London, Minnesota.

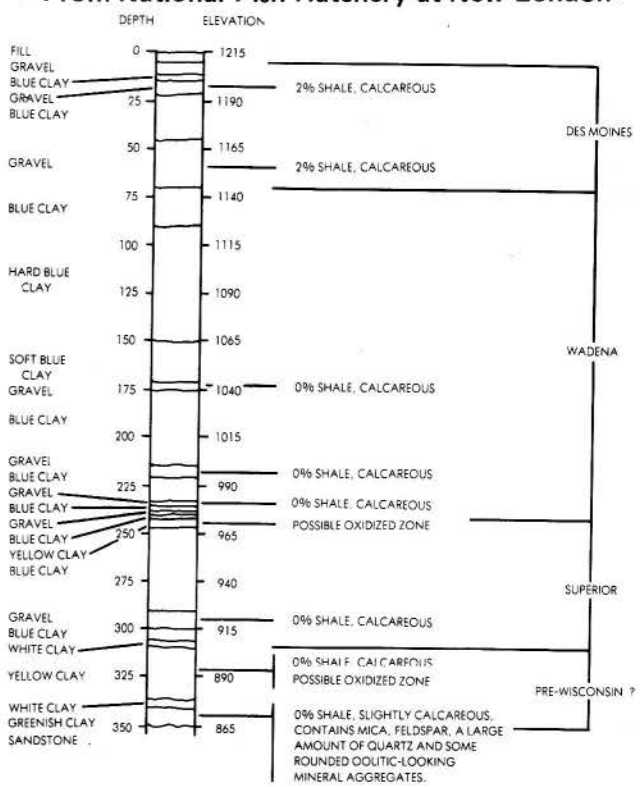
Depth (feet)	Elevation (feet)	% Shale	% Carbonate	% Crystalline
12-20	1203-1195	2	43	55
47-60	1168-1155	2	49	49
60-70	1155-1145	0	53	47
121-175	1094-1040	0	66	34
215-222	1000-993	0	50	50
233-235	982-980	0	51	49
240-247	975-968	0	52	48
247-291	968-924	0	35	65
291-300	924-915	0	50	50
308-335	907-880	0	10	90
340-350	875-865	0	21	79
350-355	865-860	0	1	99

area. It makes up the core of the Alexandria moraine (Wright, 1962) and has been reported as far south as the Minnesota River Valley (Matsch, 1972).

The total depth of all the glacial drift in the New London-Spicer area can be estimated by looking at well logs and elevations. In the area that was studied, the drift is thickest in the Alexandria moraine and thinnest to the south and west. A deep well at the National Fish Hatchery in New London was drilled in 1977. The well log report and a pebble count of the screenings was made in order to separate subsurface units. Since the screening samples were small in size and quantity (75 cubic centimeters in volume and less than 4 mm in size) the data may contain some inaccuracies.

The total thickness of glacial drift at the National Fish Hatchery well site is 335 feet. Pebble analysis of well screenings (Table 2) indicates that the Des Moines drift covers the surface to a depth of 60 feet. Pebble counts average 2 percent shale, 46 percent carbonate, and 52 percent crystalline rocks. The Wadena drift underlies the Des

Well Section With a Description of Screenings From National Fish Hatchery at New London



Moines drift and is 180 feet thick. Pebble counts from the Wadena drift average 0 percent shale, 54 percent carbonate, and 46 percent crystalline rocks. An earlier Superior drift underlies the Wadena and is 60 feet in thickness. Its upper surface is composed of a yellow clay. This oxidized zone may represent an old weathering surface or paleosol. Pebble counts for the earlier Superior drift average zero shale, 42 percent carbonates, and 58 percent crystalline rocks. Below the Superior drift is 30 feet of weathered deposits which may represent a pre-Wisconsin drift just above bedrock. Pebble counts average zero percent shale, 11 percent carbonates, and 89 percent crystalline rocks. The deeper screenings, 335-355 feet deep, were white sand or sandstone containing mostly quartz, but some mica and feldspar. This second zone of oxidation may be aweathering surface developed on bedrock or on the pre-Wisconsin drift.

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