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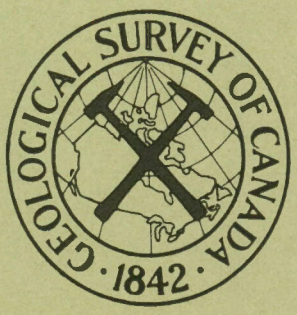

GEOLOGICAL
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DEPARTMENT OF ENERGY,
MINES AND RESOURCES

PAPER 66-36

SURFICIAL GEOLOGY OF THE WATERHEN-GRAND RAPIDS AREA, MANITOBA 63 B, 63 G

(Report and Map 13-1966)

R. W. Klassen

Price, $1.50

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ABSTRACT

This report is concerned with an area within the Manitoba Plains physiographic province.

Ground moraine, which covers much of the area, is composed mainly of light grey, silty, stony till derived largely from carbonate bedrock. This is commonly capped by from 1 foot to 3 feet of clayey brown till, stony brown clay and/or lag gravels.

Although the upper few feet of the surface deposits commonly show the effects of lacustrine erosion or deposition, glacio-lacustrine deposits are mainly restricted to narrow belts of coarse beach gravels.

Minor intersecting lineaments, easily seen on air photos, were apparently formed by the action of floating lake ice and are not due to permafrost, wave action, running water nor are they reflections of bedrock fracture patterns.

Distinctive tills indicate that there were two intervals of glaciation, the first characterized by ice flow from the northwest the second by flow from the northeast.

SURFICIAL GEOLOGY OF THE WATERHEN-GRAND RAPIDS AREA (63B, 63G), MANITOBA

INTRODUCTION

The map-area is within the Manitoba Plains physiographic province. It is bounded by latitudes 52° and 53°30'N and longitudes 99° and 100°W and includes the northern part of the Interlake area.

The accompanying map is largely interpretive and is based on a study of air photos. Ground control was established along the new Highway 6, between Gypsumville and Grand Rapids and along a number of branch roads. Fresh road cuts and borrow pits near the recently completed Grand Rapids dam provided some good exposures of the drift.

PHYSIOGRAPHY AND BEDROCK

Most of the surface in the map-area is a gently irregular plain. Within townships 45 and 46 the plain is broken by a steep, south-facing escarpment that marks the front of The Pas Moraine. The topography generally reflects the bedrock surface.

Most of the area is underlain by yellowish grey dolomite of Silurian age (Baillie, 1951, map). Similar dolomite of Ordovician age outcrops in a belt 5 to 20 miles wide along the west side of Lake Winnipeg (Baillie, 1952, map), and reddish dolomite, limestone and shale of Devonian age is found in the southeastern corner of the map-area (Davies, et al., 1962, p. 137). Drift, 1 foot to 5 feet thick, mantles the bedrock in most accessible areas south of the front of The Pas Moraine, though in places a bedrock surface with some 100 feet of local relief has been partly, or entirely subdued by drift. Northerly oriented bedrock ridges about 1/2 to 1 mile wide and up to 70 feet high, and mesa-like rises are distinctive landforms from Grand Rapids northward (map-unit R).

SURFICIAL DEPOSITS

Ground Moraine

Ground moraine covers most of the map-area. Much of it is poorly drained and covered with numerous bogs and swampy flats. Its surface has commonly been modified by the action of lakewater. On relatively elevated terrain the fines have been winnowed from the till resulting in the formation of thin patches of gravel over till or bedrock; in low areas the fines resulting from the winnowing have been deposited over till.

The ground moraine is composed of light grey, silty, stony till derived largely from carbonate bedrock. The till is commonly capped by 1 foot to 3 feet of clayey brown till, stony brown clay, and/or lag gravels. It is commonly difficult to determine whether the clayey unit is solely of lacustrine origin or whether it has been modified subsequently by an overriding glacier. In places there is evidence for the latter, as contorted inclusions of brown, clayey till occur within the grey, silty till and vice versa. Elsewhere the clayey unit is massive and contains fewer stones than the grey till. At least 12 feet of clay is exposed along the bank of a small creek crossed by Highway 6 (NW 1/4 sec. 5, tp. 45, rge. 11) beyond the front of The Pas Moraine. Slightly stony, laminated clay in the lower part grades upward into stony clay including contorted laminae. The material in the upper part of this section is similar to the clayey unit seen elsewhere in the map-area. The clayey unit that commonly overlies the grey till apparently includes both till derived from lake clay, and undisturbed lake clay. The nature of this study did not permit mapping of the clayey deposits as separate units.

The till is generally thickest in low areas. Near Grand Rapids more than 60 feet of till is exposed adjacent to a bedrock ridge (NE 1/4 sec. 16, tp. 48, rge. 13) along the Saskatchewan River. Borings along the northern end of Lake Manitoba, some 20 miles south of the map-area, penetrated more than 100 feet of drift.

Two, and possibly three tills are exposed in a borrow pit near the Grand Rapids dam powerhouse (NE 1/4 sec. 21, tp. 48, rge. 13). A description of the section follows:

Unit	Description	Thickness (feet)
3	Clay: dark greyish brown (10YR 4/2 wet); greenish brown mottles in places, slightly stony; massive, till-like structure; sharp contact with Unit 2	2
2	Till: very pale brown (10YR 7/3 wet) or light grey (10YR 7/1 wet); silty; stony; oxidized; includes a striated boulder pavement of carbonate and shield boulders with striae oriented mainly north; sharp contact with underlying till	2
1	Till: light grey (10YR 6/1 wet) or light brownish grey (2.5Y 6/2 wet); silty; stony; oxidized; much harder than Unit 2	16

The ground moraine has been divided into three map-units which are distinguished primarily on the basis of the thickness of the drift and the

presence or absence of minor intersecting lineaments. Map-unit 1 includes areas where thin till, commonly less than 4 feet thick, mantles the bedrock. This map-unit is restricted to broad belts some 15 to 20 miles wide, and 50 to 100 feet above adjacent areas of ground moraine. It is generally fairly well drained, apparently because of the higher altitude and greater fracture permeability of the bedrock. Map-units 2 and 3 include areas of thicker drift that have generally poorer drainage than the areas included in map-unit 1. These last two map-units were differentiated on the basis of the presence (in map-unit 2) or absence (in map-unit 3) of minor lineaments (see Minor Lineaments).

The Pas Moraine

The Pas Moraine forms a topographic high, arcuate in plan and asymmetric in profile, that continues west and northwest of the map-area to a position north of The Pas. The crest of the moraine within the map-area is near the edge of a southward facing, beached escarpment. From the crest of the escarpment to the plain immediately south of it the elevation drops some 100 feet in about 1,000 feet, whereas to the north there is an almost imperceptible drop of about 100 feet in about 10 miles. Ground moraine forms the surface north and south of a beach complex (map-unit 4) 1/4 to 1/2 mile wide, associated with the moraine front. Fluting on the surface of the moraine at right angles to the moraine front is evident on air photos but is not easily recognized on the ground. Crests of the ridges are about 1/2 mile apart and the relief is low.

The escarpment is formed from a thick accumulation of till. Road cuts and borrow pits, particularly along Highway 10 west of the map-area, expose hard compact till, tens of feet thick, overlain by 5 to 15 feet of poorly to well-sorted beach gravel.

Within the map-area The Pas Moraine appears to be composed entirely of drift that was probably deposited before the last glacier advance. The fluted nature of much of the surface suggests that it was overridden. Ice-flow markings north of the escarpment are oriented in the direction of well developed glacial grooves south of the escarpment. West of the map-area, however, near The Pas, the moraine marks the boundary between ice-flow markings oriented to the southwest above the escarpment, and to the southeast below the escarpment (Craig, 1966, p. 139). Bedrock east of the escarpment in that area has a significantly higher elevation than it has west of the escarpment and the moraine trend is roughly parallel to the regional strike of the bedrock, suggesting that the moraine there, in part, comprises an accumulation of till on the lee side of a bedrock escarpment.

Glacio-lacustrine Deposits

The upper few feet of the surface deposits in the map-area commonly show the effects of lacustrine erosion or deposition. Lacustrine deposits

of significant thickness are mostly restricted to narrow belts of coarse beach gravels (map-unit 4).

Beaches are the principal minor landforms in the map-area. They are best developed along the front of The Pas Moraine where three successive levels of beaches or terraces occur at about 40-foot intervals. The highest beach altitude recorded was 970 feet at the crest of the moraine along the north end of Kawinaw Lake. The beach ridges, 5 to 20 feet high and 50 to 300 feet wide, are composed mainly of sand and gravel. Where Highway 6 crosses the escarpment in NW 1/4 sec. 15, tp. 45, rge. 12, some 40 feet of mainly coarse beach gravel is exposed. Sand commonly fills the space between the rocks, though some zones include only well-sorted pebbles. Beach deposits similar to those described above mantle the sides of prominent bedrock ridges. In township 49, range 13, north of Grand Rapids, along the eastern side of a bedrock ridge facing Lake Winnipeg, beaches grade into bedrock terraces. Such terraces are absent along the west side of the ridge, which is covered by beach sands and gravels in places more than 30 feet thick.

Small patches of thick laminated to massive clay are present near Grand Rapids and along some streams south of The Pas Moraine. Silty clay, some 20 feet thick, is exposed in a borrow pit (NE 1/4 sec. 18, tp. 48, rge. 13) near the Grand Rapids dam spillway. The paucity of pebbles and the presence of some weakly developed laminae suggest a lacustrine origin for this sediment which otherwise appears identical to the underlying silty grey till and is separated from it by a striated boulder pavement.

Minor Lineaments

Minor intersecting lineaments, plainly visible on air photos, are present on much of the surface bordering Lake Winnipegosis and in smaller areas near other lakes (map-unit 2). They are restricted to low-lying parts of the map-area and are not apparent in slightly higher areas where relatively thin drift commonly mantles the bedrock.

Lineament patterns identical to those of the map-area are present over a large part of the central Lake Agassiz basin (Clayton et al., 1965, pp. 652-656). They apparently formed by the action of floating lake ice and not primarily as the result of permafrost, wave action and running water, or of a fracture pattern in the underlying bedrock as suggested by various workers (ibid.).

GLACIAL HISTORY

Two intervals of glaciation are recorded by distinctive tills within and immediately south of the map-area. Most of the different orientations of ice-flow markings within the area are believed to be the result of the two

intervals of glaciation as they correspond to the directions of successive regional flow patterns, i.e. flow from the northwest followed by flow from the northeast (Elson, 1962, p. 12). The westerly oriented striae near Grand Rapids suggest an interval of glaciation preceding the two mentioned above.

The strongest recorded phase of glacier flow across the map-area formed southeast oriented grooves in bedrock in the southern half of the map-area. Most of the silty, grey till was probably deposited by this glacier, and it may have built much of The Pas Moraine when it retreated and the direction of flow shifted to a more southerly and southwesterly direction. The ice retreat in the map-area may have been the northern continuation of the major interval of deglaciation during which Lake Agassiz I formed (see Elson, 1962, p. 12).

The last glacier advance in the map-area was that of a relatively thin glacier flowing in a south-southwesterly direction to a position south of The Pas Moraine, possibly south of the map-area. The direction of movement is indicated by bedrock grooves and a striated boulder pavement north of the moraine, by similarly oriented grooves immediately south of the moraine, and by south trending striae superimposed on southeast trending bedrock grooves in the southern part of the map-area. This glacier advanced into a lake and over lake deposits, and in places formed the clayey till.

Lake Agassiz II covered the map-area after final deglaciation. The beach deposits and terraces between 890 and 970 feet altitude along the front of The Pas Moraine in the map-area are continuous with beaches near The Pas named "The Pas beaches" by Johnston (1946, p. 4), and correlated by him with Upham's "Niverville beaches" 20 miles southeast of Winnipeg. The strong development of The Pas beaches suggest lake levels that persisted for some time. Some of the north trending discontinuous beaches south of The Pas Moraine within range 11, may correlate with the Gimli beach (ibid.), whereas other discontinuous beaches in the map-area of somewhat lower or higher altitudes formed around islands that emerged during late stages of Lake Agassiz II.

Final draining of Lake Agassiz II about 8,000 years ago (Elson, 1962, p. 6) resulted in the development of bogs over much of the map-area. Peat from the bottom of a bog 5 feet thick (lat. 52°53'N, long. 99°08'W) near the crest of The Pas Moraine is 4,670 ± 130 radiocarbon years old (GSC-410).

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