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Pleistocene Geology of the Galt Map-Area

By

P. F. KARROW

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GEOLOGICAL MAP
(In Map Case)

Map No. 2010—Pleistocene Geology of the Galt Area, Southern Ontario,
(Preliminary Edition). Scale, 1 inch to 1 mile.

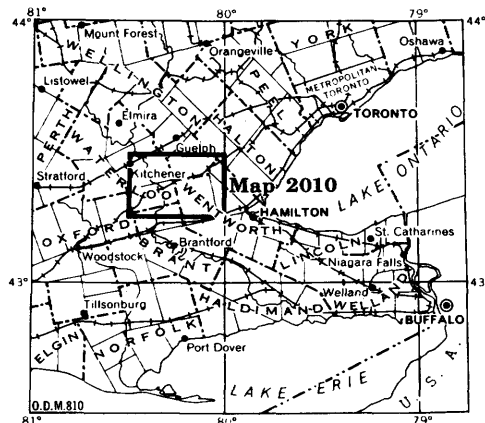
Pleistocene Geology of the Galt Map-Area

BY
P. F Karrow¹

Abstract

The Galt map-area is located in the peninsula between Lake Huron and Lake Ontario. Field work consisted of the examination of cuts, soil augering, the digging of test pits, and the location of water wells for information on the thickness of overburden and nature of the bedrock surface.

The formations underlying the area are of Silurian age. They consist of the Lockport-Amabel Dolomite, the Guelph Dolomite, and the Salina Formation. The Salina is not exposed in the area. In the east, drift is thin, and bedrock outcrops are extensive, revealing a gently-sloping bedrock surface. In the west, drift is as thick as 350 feet, and an irregular bedrock surface is indicated.



Key map showing the location of the Galt map-area. Scale, 1 inch to 50 miles.

The Pleistocene succession is best exposed along the Grand River near Kitchener. Three ice advances deposited a lower sandy till, varved clays much reworked to form a middle clay till, ablation deposits of sand and gravel, and an upper sandy till called the Wentworth Till. A small part of the southeast corner is underlain by gray silty Halton Till. Large moraines and extensive outwash deposits were laid down in much of the map-area during the retreat of the ice.

Glacial lakes of the Lake Erie basin left shorelines at 905 feet and several lower elevations. Laminated lacustrine sands, silts, and clays form a lake plain in the southern part of the area.

¹Geologist, Ontario Department of Mines.

Introduction

This report is a summarized description of the geological features studied during the field seasons of 1958 and 1959 in the Galt map-area, located immediately west of the Hamilton map-area (Karrow 1959) in the peninsula between Lake Huron and Lake Ontario.

Various field methods were employed: test pits were dug; soil samples were taken with augers; existing cuts were examined; and several hundred existing water wells were located from which information about the depth of the overburden and the nature of the bedrock surface was obtained. These four methods were the major sources of information. Results of both laboratory studies and further field work may necessitate revisions of conclusions reached during the field work of 1958 and 1959.

Physiography

Regional physiography has been treated by Chapman and Putnam (1951). Most of the physiographic features of the map-area are of drift origin. Bedrock surface is of low relief, according to available evidence. The major exception to this is the partly buried Dundas valley, a small portion of which crosses the southeast corner of the map area; the lowest topographic elevation occurs here at about 425 feet above sea-level.

In the southeast part of the map-area till drumlins, 25 to 125 feet high, rest upon an extensive bedrock plain that is underlain by Silurian dolomite. Raised shore features appear on many of the drumlins. Near the south boundary of the map-area, laminated clays and silts form a lake plain that has been deeply dissected by streams. Most of the lake plain and bedrock plain occurs between elevations of 750 and 900 feet above sea-level. Preliminary instrument surveys indicate that the elevation of the most prominent raised shore line is at 905 feet; others occur at various elevations below this.

The Galt moraine runs diagonally across the map-area, northeast to southwest, through Morriston and the east limits of the city of Galt. A fine example of morainic topography, it is a mass of glacial deposits 100, or more, feet thick and one and a half to three miles wide. Two small moraines, lying east of and parallel to the Galt moraine, extend through Valens and a location just east of Puslinch.

The Paris moraine, the second large morainic belt, lies northwest of the Galt moraine; an outwash plain, up to two miles in width, separates the two moraines. The Paris moraine, as it is traced to the southwest, becomes less clearly defined, having been cut through by meltwater channels.

The country between the Speed and Grand rivers is a part of the Guelph drumlin field. These drumlins are usually lower and narrower than those east of the Galt moraine.

The northeast extremities of several moraines coalesce near Ayr. The Tillsonburg moraine, and the combined Ingersoll and St. Thomas moraines, can be identified as rolling ridges of fine, sandy to silty, till and fine sand.

Extensive pitted outwash plains and meltwater channels between 950 and 1,050 feet elevation occupy the district northeast of Ayr. Between Ayr and Kitchener is a large tract of morainic topography, much of it over 1,100 feet elevation, known as the Waterloo moraine or sand hills, in which tills of varying texture occur at random; large masses of sand appear to make up the bulk of the deposit.

Kame deposits are widely distributed, forming many of the higher hills of the map-area. Particularly notable examples are those near Centreville and Doon, having elevations of 1,225 and 1,150 feet respectively. The top of the former hill is the highest point in the map area. Eskers are often associated with kame deposits, the most notable examples being in the vicinity of Freulton.

Bedrock

Outcrops of thin-bedded to massive dolomite (Guelph Dolomite and Lockport-Amabel Dolomite of Silurian age) are extensive between Hayesland and Sheffield, where overburden is thin or non-existent. Outcrops also occur along Fairchild Creek, Spencer Creek, Speed River, and Grand River between Galt and Preston. Small domes and anticlines, apparently caused by reefs, are typical of these rocks. Rock cuts along highway No. 8 near Sheffield, and on highway No. 401 west of Guelph Junction, show these structures well. These ridges have a bearing of about N. 20° E. and control the drainage pattern over a small area north of Sheffield.

According to Caley (1941) the Salina Formation underlies the area west of Grand River but no outcrops are known. The small area underlain by the Dundas buried valley probably includes formations of earlier Silurian age but, since the total depth of the valley is unknown, the identity of these rocks is open to speculation.

Bedrock Surface

The bedrock surface has a regional slope from an elevation of about 1,000 feet above sea-level at the north edge of the map-area to about 700 feet near the southern boundary. In the southeast corner of the area, bedrock surface falls away rapidly to an unknown elevation below 300 feet in what is known as the Dundas buried valley. A small buried valley, probably tributary to the Dundas valley, passes about one mile northwest of Peter's Corners. It has a depth of 50 to 75 feet and its course is followed by Spencer Creek for about 5 miles from a point one and a half miles south of Strabane.

The bedrock surface becomes increasingly irregular to the west, and the number of water wells reaching bedrock decreases to the north and west, so that contours on the bedrock surface are poorly defined in the west half of the map-area. The least favourable district in this regard is west of the Grand River and south of Blair and Strasburg where only five wells reach rock within an area of about 55 square miles. The very generalized picture these wells create is that of a broad bedrock trough striking northwest through Ayr and having basal elevations near 600 feet. The rock surface rises to about 800 feet in the southwest corner of the map-area and to over 900 feet in the northeast near Galt and Williamsburg. Farther north and east, bedrock valleys about 50 feet deep are indicated. One valley extends from a point west of Preston, through Centreville, to a point west of Breslau, perhaps marking an earlier course of the Grand River.

Drift thickness increases in the northern and western parts of the map-area. The Galt and Paris morainic belts range in thickness from 100 feet in the north to over 200 feet in the south. Associated outwash deposits east of the Grand and Speed rivers are 30 to 70 feet thick. Between the Speed and Grand rivers, the drift is usually 50 to 100 feet thick. West of the Grand River the thickness of drift increases to between 150 and 200 feet near Kitchener, and further increases to over 300 feet near Williamsburg and Roseville, then decreases to 200 feet or less at a location south of Ayr.

Pleistocene History and Deposits

The oldest Pleistocene deposit thus far identified in the area consists of dense, sandy to silty, stony till whose colour varies from grey buff to olive. It is exposed intermittently in the banks of the Grand River from Bridgeport to Doon. The pebbles in the till (three localities) are about 60 percent dolomite, 25 percent limestone, 1 percent red shale, and 10 percent crystalline rocks, indicating an eastern source that is likely the Lake Ontario basin. The till has an exposed thickness greater than 30 feet and is believed to extend under much of the area west of the Speed and Grand rivers. It has been encountered in borings in Kitchener. Possibly other till sheets are present below or within the exposures of this till; but their limited exposure prevents distinguishing either between the facies changes within a single till, or the presence of more than one till, or both.

Wherever the aforementioned Pleistocene deposit of sandy till is found exposed in a cut or section, it is overlain by a complex of varved clay and clay till. The varved clays are often intensely contorted, and they grade into clay till in which remnants of reworked sediments are sometimes visible. The colour of this complex is usually dark grey with a slight reddish or brownish tint. The pebble count is low, but a count of these pebbles (one locality) suggests a composition similar to the lower sandy till and indicates ice movement from the Lake Ontario basin. The red shale present in the two tills, and the reddish colouring in the varved clay and clay till, are believed to be derived from the Queenston Shale which outcrops east of the map-area. The thickness of this complex is variable, but is most frequently about 20 feet; it occurs in exposures not only along the Grand River, but also in the hill slopes north of Kitchener where the overlying deposits become thinner.

The sequence of events recorded by these deposits is that of two ice advances of unknown age and magnitude separated by a lacustrine interval during which a high-level lake existed (elevation over 1,000 feet). Because of limited exposure, all of these deposits are grouped together in a single map unit that may be conveniently referred to as the lower beds (3).¹

Exposures of tills of varying textures (4) occur southwest, west, and northwest of Ayr. In general, the texture becomes finer from south to north, and weathering becomes more intense northward. Pebble counts on these tills (four localities) show an increasing limestone content (23 to 42 percent), and a decreasing dolomite content (55 to 28 percent) northward, with variable amounts of red shale (0 to 6 percent) and crystallines (8 to 21 percent). Here too, an eastern source is indicated by the presence of red shale. Further field work is required to correlate these tills with the sequence found elsewhere in the map-area. It should be noted that this is an area of coalescing end moraines as interpreted by Chapman and Putnam (1951).

Wentworth Till was the name applied (Karrow 1959), in the Hamilton map-area, to a sandy till occurring in drumlins near Carlisle. This till is extensively exposed in the Galt map-area in drumlins, in the Galt and Paris moraines, and in numerous other localities. It appears to become thin to the northwest, near Kitchener, and its outermost limit is believed to be not far beyond the map-area. It is usually separated from the lower beds by sand and gravel deposits of kame and outwash origin. The texture varies from fine to coarse sandy till; the coarser textures, with high content of cobbles and boulders, are prevalent in the northeast part of the map-area where the rough bedrock surface allowed more quarrying

¹Bracketed numbers refer to map-units shown on the accompanying geological map (No. 2010, in map case).

action by the glacier. The colour of this till varies from buff to pink-buff, the red colour being generally more prominent in the south along the trend of the buried Dundas valley, and in the east, closer to the Niagara escarpment. Pebble counts at ten localities show that the dolomite content west of the Niagara escarpment increases rapidly until the composition averages about 70 percent dolomite, 18 percent limestone, 6 percent crystalline, and 2 percent red shale.

This composition, when considered together with the trends of both the striae and the drumlins, amply demonstrates that the Wentworth Till was deposited by westward-moving ice. This ice advanced over kame and outwash deposits near Kitchener and extended an unknown distance beyond this before retreating. During retreat, the ice left behind it many stranded ice blocks to form the kettles in the pitted outwash plains southwest of Galt. Some of the larger depressions or kettles extend below the present water table to form kettle lakes; Pinehurst and Puslinch lakes are examples. Large quantities of meltwater distributed sand and gravel in extensive outwash deposits (7); close to the ice, cones and irregular heaps of gravel formed kames (6). The farther the outwash gravels were carried downstream from the retreating ice, the better sorted and rounded they became. Large quantities of sand (10), near and south of Kitchener, were deposited before and after deposition of the Wentworth Till. Scattered eskers, numerous kettles, and large kame deposits indicate that the ice sheet stagnated while melting away.

Halton Till (8) is found only in the Dundas valley. Usually a buff-weathering grey silt till with low pebble content, it postdates the deposition of the Wentworth Till although the time interval represented here is unknown.

The presence of ice at the edge of the Niagara escarpment maintained glacial lakes in the Lake Erie basin. Raised shore lines were cut in the drumlins south of the Galt moraine at 905 feet and at various lower elevations. Wave action cut terraces in the ends of the drumlins and the eroded till was washed to the north side of the drumlins where it was deposited as gravel cones and incipient spits of angular well-sorted gravel (11). Lake-bottom deposits of laminated and varved sands, silts, and clays, are found between Sheffield, Troy, and Peter's Corners and are believed to extend far to the south. Estuarine, deltaic, and shallow-water lacustrine sand (10) often overlie the clays near exposures of bedrock and near former stream mouths.

Kettles and abandoned meltwater channels have been filled in to varying depth by organic soil (12). Peat, and, more commonly, muck and marly muds, have accumulated to considerable thicknesses in some places.

Modern stream deposits (13) are related to the materials the stream is eroding. The Grand River is depositing gravel in many of its meanders. The Speed River flows on, or only slightly above, bedrock and has deposited a thin layer of muck and sand along its course. The exposures of bedrock along the Speed River and along the Grand River near Galt have favoured relatively straight stream courses and have hindered erosion. Bedrock acting as a local base-level in the Grand River has probably been the cause of its meandering course northwest of Preston.

Economic Geology

GRAVEL AND SAND

Most of the known gravel and sand pits are shown on the geological map (No. 2010, in map case). The types of gravel deposits being worked, in order of their importance, are outwash, eskers, beaches, and kames.

Outwash gravels are available in large quantities in three districts: along the Grand and Speed rivers; in outwash plains between Galt and Ayr and southwest of Aberfoyle; and southeast of Freulton. Such gravels are moderately to well sorted and contain only minor amounts of shale.

Eskers are most common near Freulton with other good examples southwest of Galt and northwest of Preston.

Beach gravel deposits are probably the cleanest and best sorted, but are not of large volume. These deposits are generally found in small projecting spits on the north sides of drumlins south of the Galt moraine.

Kame deposits, which are numerous and large, are currently the least attractive source of gravel. This is reflected in the fact that they are seldom utilized because of the unreliable characteristics of sorting which make their exploitation a gamble. It is reasonably certain, however, that these deposits constitute a large reserve of gravel that will be more attractive when the higher-grade outwash deposits become depleted.

Sand is usually available in large quantities from gravel pit operations, and separate sand pits are uncommon.

CLAY

No clay pits are known to be operating within the map-area. Supplies for local industries at present come from pits outside the map-area. Lake deposits south of the map-area probably are the closest source of such materials; the deposits within the map-area appear to be too coarse.

WATER

The map-area may be considered in two parts in relation to water supply. The one part is a region of little drift southeast of the Galt moraine where water is obtained from the bedrock and from shallow drift wells. Two buried valleys occur within this part of the map-area. The valley underlying Spencer Creek appears to be filled with sand, and should provide substantial volumes of satisfactory water. The valley known as the Dundas buried valley yields satisfactory water from shallow wells, but gives only mineralized water from deep wells.

The other part is a region of deep drift where some wells are deep enough to tap bedrock aquifers, but where most wells obtain water from permeable drift aquifers such as outwash gravels and sands, and kame deposits. This is particularly true in the district lying west and southwest of Galt, and no doubt other large sources of water exist untapped in deeper drift beds and in the bedrock in this district.

ENGINEERING GEOLOGY

Portable seismic equipment is probably useful for measuring drift thickness in the southeastern part of the map-area where drift is thin and the dolomite bedrock provides a high-velocity medium below the drift. Elsewhere the overburden is usually thick enough to exclude bedrock from consideration in construction. However, in the eastern part of the map-area, when confirmation of drift thickness and depth to bedrock is required, detailed studies should be made of the irregular bedrock surface in this area of reef-development.

Foundation problems have not been difficult as yet in Kitchener, the largest city in the map-area, because of the lack of high buildings. For this reason little is known of soil conditions in the city. It is expected that water may often be a

problem in the fine sands common in the district. These sands are apparently thick enough to provide a raft foundation for most buildings. When deeper foundations and higher loading become necessary, greater difficulties may arise from the unfamiliar conditions of the underlying clay till and varved clay. The other cities in the map-area are located on outwash plains with good foundation conditions.

Bogs are numerous, and have caused many problems in road building. The depth of the bogs must be determined before an intelligent decision can be made about construction methods; that is to say, whether to float the road, or to excavate and backfill. The deepest are the kettle bogs, depths greater than 15 feet being frequently encountered. Channel bogs are usually much shallower, and therefore present much less of a problem.

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