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SURFICIAL GEOLOGY OF OTTAWA MAP-AREA, ONTARIO AND QUEBEC

The map-area lies astride the southern margin of the Canadian Shield. Precambrian rocks, which locally include mostly granitic rocks and Grenville-type metasedimentary gneisses and crystalline limestones, lie in three main parts of the map-area: the Gatineau Park area northwest of Hull, an area northeast of Gatineau townsite, and one northwest from Hazeldean. The rest of the map-area is underlain by Lower Palaeozoic rocks. These are dominantly limestones, but there are important exposures of sandstone and shale in a few places. Bedrock geology of the area has been detailed by Wilson (1946).

Field work in 1961 revealed evidence of only one, southward-moving glaciation in the map-area. As this ice-sheet derived its materials from local bedrock, the glacial till and related sediments (map-unit 1) reflect the composition of underlying and nearby bedrock. Till in the hills in the northern part is composed mainly of siliceous, granitic materials, but locally is calcareous near bodies of crystalline limestone. Elsewhere the tills are highly calcareous owing to a dominance of limestone bedrock at the surface. Igneous and metasedimentary rocks from Precambrian sources comprise most of the pebbles and boulders of glacial sediments in the northern part of the area, and as much as half of the volume of glacial sediments in other parts.

Despite reports (Johnston, 1917) of gravels older than the till of the area, none were recognized during this investigation, and deposition of glacial gravels appears to be mainly contemporaneous with the last glaciation. Poorly sorted, angular-particled glacial gravels and sands (map-unit 2) occur mainly in ridges where they are intimately related to minor sheets of glacial till (map-unit 1) and some minor silt beds. Abrupt changes of size of materials, and common, steep, southward dips indicate the deposition of these gravels and sands by meltwaters from an ice-margin that lay to the north of the existing ridge. Related till sheets interbedded with and truncating gravel and sand strata probably resulted from the slumping of semi-fluid masses of glacial till from the ice-front as well as from deposition during minor readvances of the ice-front over a frontal zone where moraine had accumulated.

Present exposures show that a morainic ridge (map-unit 2, in the main) probably extends from Bells Corners, through Merivale Gardens, Uplands Airport (Bowesville), Gloucester Station, South Gloucester, and southward for a number of miles beyond the map-area. Johnston (1917) recognized the morainic nature of this "Bowesville" ridge. A short segment of another moraine, perhaps related to the above, extends eastward from near Uplands through Gloucester.

A third morainic ridge extends southeastward across the southwest corner of the map-area, through Huntley and Stittsville; its northern end is truncated by the valley of Carp River. A parallel and probably related ridge has its northern end at the south margin of the map-area, in the hill that is circumscribed by a meander of Jock River; it extends about 8 miles southeastward to meet Rideau River at Kars (Reinecke, 1917).

A lobe of glacial ice apparently occupied the valleys of Ottawa and Gatineau Rivers, and at one time during late Wisconsin time stood on the northeastern side of the morainic ridge at Stittsville; then when it diminished, one part of the ice-front was anchored in the rugged bedrock terrain in the west-central part of the map-area while the free margin of the ice lay along the moraine that crosses the Rideau River at Uplands. Further recession of the ice-margin produced the ridge at Gloucester and perhaps also the morainic materials (map-unit 2) at Britannia Heights and in three islands at and north of Shirleys Bay. Other bodies of morainic materials (map-unit 2) in and near Ottawa and north of Ottawa River, are most probably ice-margin deposits.

Glacial-lake varves are present in Ottawa map-area, but not as a mappable unit. They are exposed chiefly in a few vertical sections within a narrow area along Rideau Valley, upstream from Uplands Airport. In all of these sections the varved silts are overlain by marine clay. The varves are few in number and grade upward into the marine clay. These observations indicate that a long narrow glacial lake formed in Rideau Valley, drained southward into other lakes in the St. Lawrence Valley, and existed for only a short time before the Champlain Sea progressively flooded into this part of the Ottawa - St. Lawrence system. There appears to have been a rapid and direct gradation between the two types of sedimentation rather than an erosional break between the glacial-lake and marine events, as postulated for areas to the south (MacClintock, 1958).

During the time that the Champlain Sea was at its maximum in the map-area, only the land now above about 650 feet elevation remained dry. In the submerged areas, soft, silty marine clay (map-unit 5) accumulated mainly in depressions, obscuring most of the minor features of the glacial topography and subduing relief of major glacial topographic features. Along its shores and in shoals developed during its recession, the Champlain Sea developed gravel beaches (map-unit 3) from glacial materials exposed to wave action, and shingle beaches (map-unit 4) from the easily eroded bedrock exposures. Glacial till (map-unit 1) surfaces were modified to the extent that up to 3 feet of coarse, poorly sorted lag gravel lies on and grades downward into the underlying till in many parts of the area. Fine sand (map-unit 6) washed from the older sediments and bedrock was deposited in near-shore zones. A large sand spit, developed by shore currents of the Champlain Sea, formed in the Uplands Airport area, where a breach probably occurred in the major moraine.

Non-marine sediments (map-units 7, 8, 9, 10) are widespread in the area. Although marine clay (map-unit 5) occurs in most depressions, it has not been found above 375 feet present elevation.

Fossiliferous beach sediments occur between about 325 and about 675 feet present elevation. At levels below about 325 feet the predominant sediments at the surface are non-marine; the true Champlain Sea clay is exposed in the few places where younger sediments have been removed by erosion. Stiff, mottled clay (map-unit 7) of non-marine origin, and in many places 20 feet or more in thickness, generally lies on the eroded surface of soft, sensitive marine clay (map-unit 5). The younger clay probably was derived in great part from older unconsolidated sediments by wave and current action during the last stages of the Champlain Sea and during subsequent estuarine and fluvial action.

When marine levels were at about 325 feet, the salinity of the water changed rapidly, causing the disappearance of the marine fauna whose shells are so abundant in the marine sediments. This change in salinity may be ascribed to a sudden influx of fresh water produced either by release of meltwater from glacial sources, or, more likely, by the sudden release of large volumes of silt-laden water from the Great Lakes region through such channels as the Fossmill and the North Bay - Mattawa outlets (Gadd, in press). The change in salinity was accompanied by the development of river currents capable of eroding scarps and terraces. Thus, oxidized, non-calcareous and non-fossiliferous, rust-mottled clay (map-unit 7) lies unconformably upon soft, unoxidized, calcareous, fossiliferous marine clay (map-unit 5), whose upper surface was probably produced by erosion but which shows no evidence of subaerial erosion. The physical differences in these two clays are best explained by assigning the older of the two to a marine or brackish-water environment of deposition - the Champlain Sea - and the younger to a fresh-water lacustrine or fluvial environment of deposition - the ancestral Ottawa River.

In the east-central part of the area a series of 'islands' are separated by broad abandoned channels now occupied in part by Mer Bleue Peat Bog. The 'islands' have a central, flat-topped core of marine clay (map-unit 5) capped by non-fossiliferous sands and gravels (map-unit 8). The channels are filled with mottled clay (map-unit 7) and sand (map-unit 8) of fluvial origin. The relationship there, of units 5, 7, and 8, proves the secondary, fresh-water origin of unit 7, and disproves the post-Champlain Sea marine origin suggested by Antevs (1925).

Ottawa River in its high ancestral stages deposited alluvial sands (map-unit 8) in channel, bar, delta, and spit deposits, and silts (map-unit 7) in broad channels and lakes that are now abandoned. Bog deposits (map-unit 10) accumulated in many of these depressions and other poorly drained parts of the area. Fresh-water marl occurs near Tunney's Pasture and McKay Lake (Logan, 1847; Whittaker, 1922) and in a few other places in Ottawa.

Ottawa and Rideau Rivers have produced terraces and islands of alluvium (map-unit 9), which is mainly fine sand with some silt and differs from older fresh-water sediments (map-units 7, 8) in that it contains much mica and disseminated organic matter.