KOUCHIBOUGUAC NATIONAL PARK

(EASTERN NEW BRUNSWICK)

GEOLOGY

by

V.K. Prest, Geological Survey of Canada

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INTRODUCTION

Kouchibouguac National Park or Kouch. Park as it is commonly and herein referred to, is situated on the east-central coast of New Brunswick. The hamlet of Kouchibouguac is located on Highway No. 11, about 25 miles south of Chatham and a mile west of the park boundary. The Kouchibouguac and Kouchibouguacis Rivers flow across the central part of the area.

The Park is situated in the Maritime Plain physiographic region. Most of it lies below an elevation of 50 feet. Only in the west-central part between Kouchibouguac and Kouchibouguacis Rivers, do elevations rise gently to slightly above 100 feet. The land surfaces slope gently north or south toward the major streams, and eastward toward the sea. In a few places along the major streams there are cliffs in the order of 25 feet but only near Kouchibouguac itself do they rise to 50 feet, and everywhere natural rock outcrops are limited. Along the eastern shores the bedrock surface slopes gently toward the sea. The rock is exposed at the high tide limit on the south side of Kouchibouguacis River at its mouth. It may be exposed at times in the tidal zone, on the outer side of parts of the barrier islands, following storms. Inland, though bedrock is commonly close to the surface, it remains concealed unless exposed by road construction or in borrow pits, ditches, and house excavations. Areas where the drift mantle is generally less than three feet thick have been mapped as bedrock. The drift mantle

is probably not more than about 20 feet thick anywhere in the Park.

Due to the gentle surface slopes and the prevalent shallow bedrock, combined with a high water 'table', the park area is, generally speaking, a wetland. Peatlands, bogs, swamps and marshes are common. The better woodlands are located on sandy or gravelly areas where marine deposits are some 3 to 15 feet thick; these are along the southern boundary of the park. The park is uninteresting in terms of physiography, bedrock types and surficial deposits.

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Glossary

Till: The variable mixture of boulders, gravel, sand and clay deposited by direct glacier action, generally at the base of the ice.

Esker: An elongate and commonly sinuous ridge, generally consisting of sand and gravel, formed in a channel in or beneath the ice during glacier recession.

Crevasse-filling: Elongate and rather straight ridges of sand and gravel believed to have formed by meltwater flowing into and along a crevasse system in a retreating glacier.

Barrier island: An elongate offshore bar or beach consisting of a number of beach ridges; these may be broken by channels, where storms have washed over the ridges, and by blowouts and dunes.

Washover channel: A channel made by storm waves that have crested a beach ridge; the resulting short-lived 'streams' flow toward the lagoon side of the ridge and deposit the eroded sand between ridges or on the tidal flats of the lagoon.

BEDROCK GEOLOGY

Kouch. Park is located in the Central Basin of the Carboniferous Lowland. The bedrock strata are Pennsylvanian-age sediments, about 300 ± 20 million years old. They comprise a monotonous succession of yellowish-grey sandstones with but minor greyish conglomeratic sandstone and reddish-brown mudstone horizons. The dry sandstones range in colour between 5Y6/4 and 5Y5/2 (Munsell Soil Color Charts). The sandstones are mainly medium to fine grained and include both calcareous and non-calcareous types. The coarser-grained sandstones, which are the greyish rocks, are commonly somewhat porous as if 'limey' groundmass material had been removed by groundwater action. The 'yellowish' tone of the finer-grained sandstones seems to be imparted by the inter-granular fine material. With increasing degree of oxidation both the 'fines' and the feldspars become distinctly yellow and the sandstone becomes 7.5YR5/8 in colour. Under very local, extreme, degrees of oxidation the sandstone may redden to 5R4/6.

The conglomeratic sandstone is greyer than the average sandstone. It outcrops boldly along Rankin Brook.

The reddish-brown mudstone or claystone (5Y6/3 when dry to 2.5YR4/2 when damp) was only seen, in a natural exposure, along Kouchibouguacis River. On the south shore, at the river mouth, it occurs as a soft 'mud' interbedded with soft, greyish sandstone and a peculiar, blotchy, intra-formational breccia. The latter consists of angular to irregular fragments of light-grey, (5Y7/2) calcareous siltstone, generally less than 1 inch in diameter in a dark, faintly-reddish sandstone matrix (about 2.5YR4/2); this is also calcareous due to comminuted siltstone. The siltstone fragments make up 60 to 70 percent of the breccia rock. The breccia is probably a lens rather than an extensive bed, as somewhat similar breccia lenses are common in other parts of the Carboniferous Lowland. The only other exposure of the reddish-brown mudstone was that seen in a road-side cut along the side of a gully, 1 mile west of St. Olivier; here it occurs beneath reddish-brown, stony-marine clay and very similar appearing clayey till. The prevalence of these latter materials in the Kouch. River valley may indicate the presence of hidden, soft, red mudstone layers, but only sandstone was seen along the river banks or the adjacent roads. Perhaps the soft character of the mudstone precludes its occurrence as outcrops, and it is more abundant than is evident.

The yellowish-grey sandstones along the Kouchibouguac River do not display well-defined pebble-breccia horizons such as are present in other parts of the Carboniferous Lowland, but they do include minor laminae or beds that contain scattered, thin fragments or shards of grey mudstone (7.5YR5/0). These appear to be flakes of semi-consolidated, quiet-water muds that

were ripped up and redeposited by the faster-flowing streams responsible for the sandstone sequence in toto. Plant debris is extremely rare, but it may be seen in the highway outcrop at Kouchibouguac. Blocks of this carbonaceous sandstone, the most massive in the park region, were used for rip-rap along the shore-road cliffs near the mouth of the Kouchibouguac River. Some of the poorly preserved plant stems are identifiable as belonging to the family Cordaitailes. Vegetal debris layers were seen between thin, platy sandstone beds that form a small coastal knoll at Point Sapin Centre just north of the park boundary. A 5-inch long cast of a Calamites sp. stem with a radius of 2 inches, found on the shore here, was the only readily identifiable fossil noted in the park region.

The sandstone strata within the park area appear to strike north-northeast to northeast and to dip gently toward the southeast - generally between about two degrees and 20 degrees, but at Point Sapin Centre the general strike may be northwest. The strata were probably deposited by east-flowing streams in a fluvio-paludal to fluvio-deltaic environment (van de Poll, 1966). The sedimentary strata of the park region, however, have not been studied in sufficient detail to assign them to any specific unit within the Peticodiac Group of van de Poll.

GLACIAL AND POSTGLACIAL EVENTS AND DEPOSITS

The unconsolidated or surficial deposits that mantle the bedrock strata in Kouch. Park are the result of glacial and postglacial events. (See Table I) All the glacial deposits relate to the last major glaciation (Classical or Late Wisconsin) and hence to the period between about 23,000 and 13,000 years ago (Prest, 1970, pp. 711-712). There is no record in eastern New Brunswick of the earlier glaciations nor of interglacial or interstadial ice-free periods

Table I

SEQUENCE OF GLACIAL AND POSTGLACIAL EVENTS

Recent-time overlap of the sea onto the land (due to coastal subsidence in the Maritimes and worldwide sea level rise); 0 to 7000 years Before Present.

Map Unit 8. Formation of barrier islands with their beach ridges, overwash channels, and dunes.

Map Unit 7. Formation of salt marsh, salt meadow, and brackish-water marsh.

Postglacial off-lap of the sea from the land (due to isostatic rebound of the land); 12,000 to 7000 years B.P.

Map Unit 6. Formation of peat bogs and swamps on the newly emerged and poorly-drained lowlands.

Map Units 4 & 5. Winnowing of older deposits by wave action with deposition of raised beaches, bars and sandy mantle deposits.

Early postglacial marine overlap (as a consequence of the relatively rapid recession of the ice sheet while the land was still depressed); ca. 13,000 to ca. 12,000 yrs. B.P.

Map Unit 3 Deposition of stony marine clay in quiet, offshore, and probably ice-choked waters.

Glaciation and deglaciation: glacier cover from ca. 23,000 to 13,000 years B.P.

Map Unit 2 Deposition of gravel and sand, within and beyond the ice, during recession of the ice-sheet.

Map Unit 1. Deposition of generally clayey and stony red till beneath the ice during active glaciation.

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of the Pleistocene Epoch. Following the retreat of the last ice sheet this glacier-depressed region was overlapped by the sea. The winnowing by the sea, of both bedrock and glacial deposits resulted in a mantle of sandy materials in some places and red, clayey materials in others. Later, as eustatic sea level rise overtook the ever-slowing, postglacial isostatic rise of the land areas, barrier islands were constructed on the shelving east coast, with muddy lagoons between them and the drowned river mouths. Meanwhile swampy conditions prevailed on the land in the Kouch. Park area, and extensive areas of peatland were developed. At present, behind the barrier islands, the relative rise in sea level is continuing to drown the estuaries of the rivers, and saltmarsh is replacing former freshwater bogs, marshes and peatland.

Glacial deposits

The common deposit left by an ice sheet is known as glacial till. In this part of the Carboniferous Lowland one might expect a greyish, stony, sand till for soft sandstone is the predominant rock type. Except for local occurrences of somewhat sandy till resting directly on weathered sandstone, however, the till is a reddish-brown, stony, clay till. It is best exposed in the Kouchibouguac River valley. Such a till might well be derived from a red-brown mudstone terrain. No extensive areas of red mudstone are known to the west or northwest of the Park area in the direction from which the main glaciers are commonly presumed to have come; nor are they known within the Kouchibouguac River valley. Perhaps there are extensive areas of red mudstone southwest of the Park. Diverse directions of ice flow have been recognized in central New Brunswick (Prest et. al., 1968) and similar diverse flow trends are indicated by scoured and striated rocks at, and near, the hamlet of Kouchibouguac. The youngest striae reveal an ice flow from the interior toward the coast; hence it is possible that the source of the red beds is in the Grand Lake region of central New Brunswick, where red mudstones are common, though this source seems rather remote for a short-lived, late, ice flow. However, red till may have been derived slightly earlier by on-shore ice flow, from either red mudstone or red drift lying east of the present coast, for there are striae and ice-scoured features that indicate an ice flow toward the southwest, — almost the reverse of the last or youngest ice flow from the interior. It is here considered that the red till relates to such a landward (southwest) flow rather than the last flow toward the sea.

Glaciofluvial deposits

The only evidence of glaciofluvial events during deglaciation of the Park area, is in the form of sporadic deposits of sand and sandy gravel at the surface and,

locally, beneath a mantle of red stony clay. Some of these occurrences 'line-up' as if parts of an esker; others as if parts of crevasse systems. The esker is exposed at the surface west of Fontaine, and may be seen in road-cuts at Claire Fontaine, and east of Kouchibouguac. It may also be seen, beneath a mantle of marine clay, on the south bank of the Kouchibouguac River. From here it may have extended southwestward to St. Théodule beyond the park boundary. It has not been traced north of Fontaine, but numerous sand bars south of the Carrigan Plain (bog land) may well reflect the former presence of esker-outwash sands in this area. The meltwaters probably flowed northward. The elongate raised bars in the Guimond and St. Louis de Kent areas are probably reconstituted crevasse-fillings, for they trend at nearly right angles to the present coast and occur at elevations from about 110 feet down to present sea level. Only at St. Louis Cape, close to sea level, was older 'core-material' seen; this is a channel gravel of either tunnel or crevasse origin.

Glaciomarine deposits

The red clay till of the Park area is commonly overlain by a poorly stratified, red, stony clay that, in part at least, represents a marine winnowing of the red till. Lacking a fresh but partly dried exposure, the stratification may not be discernible; hence the stony clay closely resembles the clay till. In general, however, the stony clay is less stony than the till but there appear to be all gradations between those two materials. Part of the stony clay must have been deposited very shortly after the clay till itself and probably in a glacio-marine environment.

Marine deposits

Glacial conditions were replaced by marine conditions in the Kouch. Park region about 13,000 years ago, but no shell-bearing materials were located to

precisely date this event. However, marine shells from deposits well below the limit of marine action have been dated at Shippegan, north of Kouch. Park at about 12,600 years B.P. and from Prince Edward Island to the northeast at 12,700 years B.P.

Faintly stratified, red, stony clay of marine origin has been noted in the Black, Kouchibouguac and Kouchibouguacis River valleys. The postglacial marine period is also represented by extensive areas of thin sand and gravelly sand, by areas of clayey sand, and by a number of prominent bars. These sandy areas and major bars must represent a winnowing of pre-existing glacial and glaciofluvial deposits in addition to erosion of the soft sandstone bedrock. This is most clearly evident where the sandy deposits contain many 'foreign' stones. The numerous small bars south of Carrigan Plain, which are readily visible on air photos, are probably very sandy. Elsewhere it is likely that a thin mantle of sandy till overlying areas of weathered sandstone, has contributed to the sandy marine deposits. The clayey-sand areas may indicate the former occurrence of thin, offshore clay beds that were winnowed as they were raised by differential uplift into a near-shore environment.

There are three major raised bars in Kouch. Park. The most striking bar or storm beach, with a maximum thickness of about 15 feet, extends east-west through the hamlet of Guimond. This markedly elongate feature is actually a composite of two or more bars or beaches. That west of Guimond formed when the sea stood about 100 feet higher than at present (due to depression of the land rather than a high eustatic sea level). East of Guimond the bar sand and minor gravel represent a sea level about 75 feet above the present. Other, smaller, bars, on-line to the east, represent a further lowering of relative sea level toward (and below) its present position. Another extensive bar system occurs 1½ miles north of Guimond where its surface ranges from slightly 100 feet to about 80 feet. The major bar system between St. Louis de Kent and St. Louis

Cape is 80 to 10 feet above the sea. At St. Louis Cape the sand mantle (in part duned) overlies a gravel that appears to be part of unmodified core-material responsible for the presence of the bars.

On the peninsula between Aldouane 'lake' and Kouchibouguacis Lagoon there is a large area of woodland that is floored by sandy gravel and gravelly sand. Along the Aldouane shore the deposits form steep banks up to 15 feet high. The amount of sand and gravel in this area suggests marine reworking of an older gravelly deposit such as an esker system or perhaps a moraine formed by a very late ice advance from the Gulf of St. Lawrence.*

The trend of the major bars in Kouch. Park is somewhat surprising, for they are at steep angles to the present shore rather than conforming to this shore or to the former coastline formed at the limit of marine action some 1.5 miles inland from the present shore. The major bars represent a winnowing of low ridges (probably originally crevasse-fillings) as relative sea level fell from the marine limit of about 150 feet in this region. When relative sea level was at 110 feet elevation, a low flat ridge between Kouchibouguac and Kouchibouguacis Rivers was the only part of the Park area above sea level. The long, narrow bar extending from Highway 11 east to Guimond and the shorter bar 1¼ miles north of Guimond were formed by wave action at this time. As sea level fell the shores of this knoll were constantly winnowed and a thin but spotty mantle of sand was deposited widely over the bedrock. (As earlier mentioned, much of this area is mapped as bedrock.) Only at the eastern ends of the bars formed at about 100 feet, was there sufficient sand for current action to form other bar-like features mainly at about 80- to 70-foot elevation but in places continuing to present sea level; this may indicate the trend of a former sandy deposit, here considered to be a crevasse-filling. A low bedrock knoll at St. Louis de Kent was exposed when

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* The last active ice to invade Prince Edward Island was from the Gulf into Malpeque Bay area; this ice lobe invaded an area of slightly older sand and gravel deposits and left a mantle of bouldery gravel. On the retreat of this ice lobe the bouldery materials were in turn reworked by the sea. The widespread and thicker-than-normal deposits of sand and gravel north and east of Aldouane 'Lake' may indicate similar events.

the sea fell to about 80 foot elevation, and bars off its eastern end also continue down to present sea level. At the eastern end of this systerm there is a gravel core or sub-strate believed to represent the original unmodified deposit, either an esker or a crevasse-filling.

The postglacial withdrawal of the sea slowed when relative sea level fell to about 30 feet elevation, as below this the sand or sandy gravel mantle is more continuous and tends to follow the present coast. The more abundant sandy gravels on the north side of Aldouane River and its estuary (Aldouane Lake) were deposited during this period, — presumably by winnowing of an older gravelly deposit, believed to be morainal in origin.

Peatland and Bogs

As the sea withdrew from eastern New Brunswick, due to differential uplift of the land following the retreat of the last ice sheet, swampy conditions prevailed in the Kouchibouguac region and organic deposits began to accumulate. Lakes and ponds were gradually filled with organic materials; this process has resulted in the present day bogs and peatlands. It is probable that organic materials were accumulating in the water-filled depressions of the Park area around 13,000 years ago but neither pollen studies nor radiocarbon datings have been made on bogs in or near the Park to substantiate this concept. In any case it is unlikely that a radiocarbon dating of the basal deposits would indicate so great an age. In southern New Brunswick, which was deglaciated slightly earlier than the eastern shore, marine shells some tens of feet below the marine limit have been dated at 13,200 years B.P., yet the oldest peat is only about 11,500 years B.P. It is common to find such a lag between the time of deglaciation and the basal layers of peat bogs. In any case, as peat is still forming today it is apparent that the peat deposits span the period from about 12,000 years ago to the present.

It is unlikely that the peatland is comprised entirely of sphagnum and sedge peat; climatic changes may have resulted in the growth of trees at times.

and hence horizons of woody peat may occur. Similarly at the present time there are local areas where spruce woods are encroaching onto peatland.

Due to the rise in relative sea level over the past several thousand years, some of the peatlands are being eroded by the sea or, are being drowned and covered by marine marsh deposits or by shoreline and gravel.

Salt marsh, salt meadow, and contiguous marshland

The present salt and brackish-water deposits of the Kouch. Park lagoons are the consequence of the relative rise of sea level over the past several thousand years. The growth of salt-tolerant plants in protected areas has served to trap mud and fine sandy materials, resulting in a mat of living and partly decayed plant and animal matter mixed with fine sediment. Because of the low, shelving shores in the Park area this mat is only a few feet thick along the inner side of the lagoons but, because of the amount of sea level rise over the past 7000 years, greater thicknesses may be expected farther offshore, and perhaps beyond the barrier islands, where it may be buried by postglacial marine sand or mud. Salt marsh was seen to rest on bedrock, older marine deposits, and bog peat. It probably overlies till in places, but this was not seen.

Depending on the shoreline conditions, the salt marsh may grade inland into salt meadow or into brackish and freshwater marshes. These marshlands can be differentiated by their ecological characteristics but on the geology map they have been grouped as one unit. They are, however, shown separately from the peatlands, even where the latter is at sea level and being overlapped by salt marsh and associated marshlands.

Barrier island, beach tidal flat; dune

The east coast of Kouch. National Park is characterized by barrier islands or bay-mouth bars. These elongate islands are the result of the slow relative rise of the sea over the past several thousand years.*

As relative sea level rose over the past 7000 years in the Kouch. Park region, the sea overlapped onto land that had been rapidly winnowed during the earlier period of off-lap or retreat of the sea. The readily available sandy materials were transported by longshore currents and thrown up by storm waves to form beaches. In those areas of abundant sand supply, commonly where glaciofluvial materials were available and/or where rivers debouch sand into the sea, a series of beach ridges may combine to form a barrier island. Remnants of beach ridges and some washover channels may be seen on the barrier islands, though they have been largely destroyed by wind with consequent blow-outs and dunes. A number of the beach ridges and washover channels are shown on the geology map but the innumerable small dunes are not mapped separately.

SUMMARY

The Kouchibouguac National Park area, from the geological and physiographic points of view, is uninteresting. Thus photos of the geology are not included in this report. The bedrock is a monotonous succession of drab, yellow-grey sandstones broken only by rare pebbly sandstone and red mudstone layers.

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*The apparent rise of sea level is probably largely the result of postglacial subsidence of a Maritimes coastal bulge as the Hudson Bay region continues to rise as a result of postglacial rebound. This effect is probably heightened by the ever-increasing weight of water on the continental shelf of the Maritimes region.

The red, stony, clay till observed in the Kouchibouguac and Kouchibouguacis River valleys is unusual in that it directly overlies the common grey sandstone of the Park region. This same till covers a broad area to the west, including areas above the marine limit, where red mudstone units are uncommon. The till may thus reflect an invasion of the Northumberland coastal region by glaciers from the north and northeast perhaps incorporating older marine clays, or mudstone from distant sources. The red, stony marine clays that mantle the red till in most places, are difficult to distinguish from the till; in places, where less stony, they show a faint lamination or bedding but nowhere is bedding well-displayed nor were marine shells observed.

Glacial striations and strongly-scoured bedrock surfaces occur on the top of the outcrop at the bridge over the Kouchibouguac River, and also on the road east from Kouchibouguac; both sites are outside the Park boundaries. The sets of crossing striations tell an interesting story of shifting ice flow from southeast to southwest and finally toward the northeast and east. It is unfortunate that the easternmost of these striae sites is not within the Park boundary so that it might be cleaned of some of the overburden and serve, for display purposes as an indication of former ice movements in this region.

The bars and storm beaches near Guimond may readily be viewed from the roads or by taking a short stroll across them, in rather pleasant woods as compared to surrounding wet woodlands or bush. A few abandoned pits provide views of the materials comprising the bars and of their internal structures. The gravels are of poor grade, being composed of the local sandstones with less than five per cent of hard, foreign pebbles and small cobbles. They have a maximum thickness of about 15 feet.

The peatlands and bogs are interesting from an ecological standpoint. Palynological studies of a major peat bog should be carried out so that the park's personnel would have information on the climatic and floral changes that shaped them over the past 10,000 to 12,000 years. Radiocarbon datings on certain increments of a diagnostic core would enhance the 'story of the bogs' since glacial times. The salt marsh record might be similarly studied, but it will only provide information over several hundreds rather than thousands of years.

The barrier islands are not particularly good examples of such features but they do exhibit some beach ridges, washover channels and washover deposits as well as the prevalent dunes and blow-outs. They are not uniformly sandy throughout their length. Locally they rest directly on bedrock, and fragments of rock are present in the sand. The sand bars and beaches also overlie peat deposits in places, so that the shoaling waters are brown with humus and clods of peat are interspersed with the sand. They may also rest on salt marsh. Travel over the barrier islands will promote the development of blow-outs and dunes, and speed the destruction of their present form.

In the course of the few days study of the geology of the Kouch. Park area no indication of any potential mineral wealth was seen. Neither the bedrock nor the surficial materials have any appreciable value. Clean sands, of course, are valuable in an area of short supply but those of the barrier islands are not unique and, in any case, they should not be removed lest the islands be destroyed, for the supply of sand is not great. Removal of sand would also have deleterious effects on the shoreline beyond the park boundaries.