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PAPER 59-7

TRIAL STUDY OF HEAVY-MINERAL CONTENT OF CERTAIN DEPOSITS OF SAND AND GRAVEL IN NEW BRUNSWICK, NOVA SCOTIA AND PRINCE EDWARD ISLAND

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By

C. R. McLeod

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INTRODUCTION

Numerous deposits of various types of unconsolidated material are known to exist in Canada. Many of these deposits have been laid down by, or subjected to, agents favourable for sorting or concentrating the material being deposited with respect to the size and specific gravity of the individual particles of which they are composed. Because most minerals of economic interest have fairly high specific gravities, concentrations of such minerals may exist in deposits that could be worked profitably now or at some future time, providing the concentrations were large enough or rich enough. To obtain more information on these possibilities and to try to evaluate and improve techniques for searching for and appraising such deposits, the writer, during the field seasons of 1957 and 1958, undertook a preliminary study of the heavy-mineral contents of certain sand and gravel deposits in New Brunswick, Nova Scotia, and Prince Edward Island. This was not a prospecting venture, but a study to help to indicate whether prospecting by private interests might be worth while and, if so, how it might be done.

Acknowledgments

The writer is indebted to many persons in the area who supplied information on the location of deposits, and to property owners who willingly permitted samples to be removed. The help of officers of the New Brunswick Department of Lands and Mines and the Nova Scotia Department of Mines was much appreciated. Valuable aid in the field was given by B.D. Stymiest in 1957 and D.R. Grant in 1958.

The assistance of the following members of the staff of the Geological Survey of Canada is acknowledged gratefully: W.A. Smith and P.J. Lavergne for mineral separations other than those performed by the writer; Miss. J. Trask for X-ray identifications of minerals; and J.P. Malone for spectrographic analyses.

Physiography

The region as a whole is a gently southeastward sloping upland dissected by valleys and broken by broad lowland areas developed on belts of weaker rocks (Weeks, 1957). Except for northern and western New Brunswick, the area is entirely bounded by sea-coast, much of which is irregular in outline. The main beaches in the area have been formed by the erosion of the less-resistant Carboniferous strata that comprise Prince Edward Island, part of the north and the entire east coasts of New Brunswick, and the north coast of Nova Scotia from the New Brunswick border to the vicinity of Merigomish Island.

Goldthwait (1924) stated that most of the shoreline of Nova Scotia has been produced by a subsidence, either relative or actual, of the coast, causing the sea to advance over the outer part of the maritime region until it reached the present level. The influences of ice-sheet, rain, rivers, winds, waves, currents, and tides have resulted in the many topographic forms found along the coasts of these provinces.

The marshes and muddy flats of Minas Basin and Chignecto Bay are chiefly the result of the racing tides of the Bay of Fundy on the easily eroded rocks, mainly the red sandstones and shales around the shores of Minas and Annapolis Basins, and elsewhere around the Bay of Fundy, as well as on the floor of the Bay, which "the swift, tidal currents sweep and scour in a vigorous manner" (Goldthwait, 1924). The more resistant rocks of the North Mountain of Nova Scotia and the Southern New Brunswick Highlands have withstood not only the effects of the tides, but also the erosion of valleys. Consequently, there are few protected coves or bays favourable for beach formation, nor is there much detrital material from which the beaches could be built.

GENERAL GEOLOGY

New Brunswick, Nova Scotia, and Prince Edward Island are part of the Appalachian region of Canada, and are underlain by rocks ranging in age from Archaean to Triassic. During Palaeozoic time two main deformations took place that resulted in northeasterly trending structures. Intrusions, varying in composition from granite to peridotite, were emplaced, chiefly in Devonian time.

The complex geology of the area has resulted in conditions favourable for the occurrence of mineral deposits. Varying amounts of iron, gold, copper, lead, zinc, manganese, antimony, and fluorite have been produced. Large reserves of zinc, lead, and copper sulphides are known to exist in the Bathurst-Newcastle area of New Brunswick. Elsewhere in New Brunswick and Nova Scotia occurrences of tungsten, tin, molybdenum, nickel and cobalt, and uranium and thorium have been reported. Thus there are metallic deposits from which placer deposits of detrital metallic minerals could have been derived, and granitic and metamorphic rocks that could produce rutile, zircon, and garnet concentrations under favourable conditions.

PLEISTOCENE AND RECENT GEOLOGY

Throughout the Maritime Provinces there is abundant evidence of glaciation. It is postulated that in early Wisconsin time local ice-caps were formed in the highland areas of Cape Breton and New Brunswick. These later became confluent with the major Quebec-Labrador ice-sheet which ultimately became part of the single vast ice-sheet that occupied Canada east of the Rocky Mountains (Prest, 1957). In much of the Maritime Provinces the glacial deposits are not thick, and the composition of the drift is closely related to that of the underlying bedrock. It is probable that the high mountains of Gaspé and the deep valley of the St. Lawrence obstructed the advance of the Laurentide ice and protected most of the Maritime area, so that the amount of foreign material carried in by the ice was greatly reduced.

Most ice-flow features that remain today as a record of the trend of the ice movements were formed by active ice in the marginal zones of the glaciers and ice-sheets. Ice flowed radially from ice-caps over north-central New Brunswick and Cape Breton, but previously there was probably a general southerly to south-easterly glacial movement over most, if not all, of the maritime area, including the Bay of Fundy, Northumberland Strait, and probably the Banks off the southern coast of Nova Scotia to the edge of the continental shelf.

As it moved forward, the ice-sheet carried enormous loads of rock debris across the area, and after melting, left it scattered over the surface as drift. The drift is of two types: the unstratified drift or till that was deposited directly by the ice, and the stratified drift that was deposited by water, mainly during the recession of ice. The unstratified drift was left as erratic boulders, ground moraines, drumlins, and terminal and recessional moraines; and the stratified drift as eskers, kames, kame terraces, and glacial-lake and glacial-marine deposits. Although the ice was able to carry its load for long distances, Goldthwait (1924) found in Nova Scotia that the drift is very largely of local derivation. He stated that, as a rule, from 65 to 85 per cent of the stones resembled the underlying rock formation, and that the finer material by its sandy or argillaceous character, showed dependence upon purely local sources.

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Several deposits of stratified drift of various types were sampled, and the samples were concentrated to obtain the heavy-mineral content. No appreciable quantities of heavy minerals were noted, probably because these deposits were laid down in so short a time that there was little opportunity for the concentration of heavy minerals, as additional material was almost continually being deposited. Sands and gravels of glacial origin do not seem, therefore, likely to contain economic quantities of heavy minerals. However, deposits that have been reworked by post-glacial waters may do so. Gold placers of this type have been worked in certain parts of British Columbia.

Recent deposits in the area are in many cases composed partly of reworked glacial material and partly of the products of erosion by streams, rivers, and waves, but in a few places they consist almost entirely of one of the types mentioned above. These recent deposits occur as river bars, flood plains, terraces, deltas, freshwater and salt-water beaches, bars, spits, tombolos, and dunes.

Gardner (1955) described the origin of deposits on beaches along the eastern coast of Australia, but the description is also applicable to similar salt-water and freshwater beaches elsewhere. According to Gardner heavy-mineral concentrations have been formed on present-day beaches in the following manner: In stormy weather the turbulence of the water brings into suspension large quantities of sand which is gradually worked forward and carried up the beach by the surf. The ebb-flow from the surf and the general return of water from the breaking storm-waves counteract the shoreward movement of sand by carrying seaward fine sediment and lighter sand grains. The energy of the returning water is however not sufficient to carry back the heavy minerals and they are deposited at or near the top of the beach. During calm weather lighter wind-blown sand, usually quartz sand, may be deposited over the heavy-mineral seams or lenses. The writer observed similar black-sand concentrations being made on a much smaller scale by gently lapping waves during extremely calm conditions on the northwest bank of Miramichi River, just above the town of Newcastle, New Brunswick.

Indications of the heavy-mineral content of beaches are, however, most obvious immediately following favourable storm conditions. If therefore, prospectors are interested in such deposits they are advised to direct their attention to the berm or crest of the beach, where concentrations are most likely to be found, before they are obscured by wind-blown sand. This is especially important where sand is present behind the storm beach and where the prevailing winds are off-shore.

The writer did not observe any concentrations of heavy minerals in lake or stream deposits or in wind-blown sands in the region, but wind-formed concentrations were seen in magnetite-bearing sands at Natashquan, Quebec, which were visited briefly for observation.

METHODS OF INVESTIGATION

Field Work

In finding sand and gravel deposits in the area, the following sources of information were used: publications of the Geological Survey of Canada and others in which many such deposits have been mentioned or described; provincial travel bureaus which have publicized most of the larger beaches; a listing of the main sand-and-gravel-pit and quarry operators in the trade directory of The Atlantic Advocate (Anon., 1958); many people in the region who gave directions to local pits or beaches; the writer's and his assistants' general knowledge of, and familiarity with, parts of the area; and finally, road traverses which resulted in finding many deposits that would not otherwise have been visited. Although a great many deposits were not seen, an attempt was made to sample all large deposits and as many as possible small ones.

Fine-grained sand was considered most suitable for sampling and concentrating, as Mackie (1925) has shown that, due to the process of sedimentation, the total percentage of heavy minerals differs in sands of different grain sizes, and also in various-sized concentrates from a particular sample, tending to be concentrated in the finer-grained portion. In most cases, samples taken for concentration consisted of 1 cubic foot of material. A representative raw-sand sample of about 2 pounds was also taken. Where exposures permitted, channel samples were cut across a measured width; on relatively flat beaches post-hole-auger samples were taken, or small pits were dug. Because of the reconnaissance nature of the project it was deemed unnecessary to try to determine the distribution of minerals throughout a particular deposit. In most cases sampling was limited to one sample or a few samples that were considered to be fairly representative of the whole deposit, but occasionally from some small deposits samples were taken only from the parts thought most likely to contain the highest percentages of heavy minerals. Where natural concentrates were observed, selected samples were generally taken to provide more of the heavy minerals for laboratory studies. If the laboratory work on the samples had shown important results, further field investigation might have been done to determine more accurately the horizontal and vertical distribution of the heavy minerals in the deposit.

(The cubic-foot samples were concentrated in the field by rocker, sluice-box, or gold-pan, or by combinations of these methods. The most efficient method was preliminary concentration of the material with the sluice-box followed by careful panning to produce a final field concentrate that was dried and bagged.) It was found that unless great care was taken with panning, much of the lighter part of the heavy-mineral content, such as garnet, was lost with the tailings washed from the pan. This also proved to be the case when using the rocker, although either pan or rocker would be suitable if the operator were prospecting only for heavier metals or minerals such as gold. The rocker used was similar to the one described by Lang (1956), except that the rockers and handle were made so that they could be detached easily to facilitate transportation. An apron of cotton corduroy was found to be more effective than burlap for saving fine-grained heavy minerals.

The sluice-box used was constructed of 1/2-inch plywood and consisted of three 8-foot sections that would nest compactly for transportation, and also would allow the lower end of the first section to fit into the upper end of the second, and the second into the third. To compensate for the differences in the widths of the sections, the slope of the third section was made slightly steeper than that of the second, which was also slightly steeper than the first. Ribbed rubber matting was cemented to the bottom of each section, forming transverse riffles that proved especially effective in saving fine-grained heavy minerals. Water, supplied by a portable gasoline-driven rotary gear pump, was pumped into a pail lying on its side with its mouth over a 1/4-inch-mesh screen at the upper end of the sluice-box. Sand was fed into the pail by hand with a small scoop, and carried by the water into and along the sluice-box, the pebbles larger than 1/4 inch in diameter being removed by the screen. Most of the heavy minerals accumulated near the upper end of the first section of the box, but some were found farther down the box. Effective concentration was found to be dependent upon the size of the material, the slope of the box, and the rate at which the material and water were fed to the box. Where magnetite was present in the sand, its distribution in the box would readily be checked by using a small hand-magnet, and the slope or rate of feed could be adjusted if a better concentration was desired. The discharge end of the box was checked frequently with the magnet in an attempt to minimize loss of heavy minerals with the tailings. After all the sample had been fed to the sluice-box, the water was allowed to run for a few minutes until as much as possible of the lighter material had been removed. Following this, the material remaining in the box was gently washed into a pail, and then carefully panned to remove the lighter material that had been held in the sluice-box. The resulting concentrate was dried and bagged for shipment and later laboratory study. To prevent loss of mineral grains, tightly woven bags proved necessary. The most suitable containers for concentrates were found to be lightweight plastic bags that could be put into cotton bags for labelling.

Most concentrates were examined in the field under a binocular microscope to determine whether or not significant amounts of heavy minerals of obvious economic interest were present. Magnetite, ilmenite, and garnet proved to be the most common heavy-mineral constituents. Gold was seen in only one concentrated sample.

Laboratory Work

The purpose of the laboratory work was to identify the heavy minerals present in the field concentrates and to estimate their percentages by weight. The concentrates were weighed and passed through a 28-mesh (Tyler) sieve. The oversize material, consisting chiefly of rock fragments, was not examined in this study. About 50 grams of the material that passed through the sieve was taken for examination. It was separated with a micro-splitter, a device for splitting small samples so that any fraction taken has a composition that approximates that of a true random sample. The strongly magnetic minerals, chiefly magnetite and pyrrhotite and foreign iron particles, were removed from the separated fraction by sweeping a hand-magnet about 1/2 inch above the spread-out sample. This process was repeated until no further grains were attracted. The magnetic fraction was calculated as a percentage, by weight, of the field concentrate. The material not attracted to the hand-magnet was separated into heavy and light fractions using a heavy liquid of sufficient density to float off quartz, feldspar, and any other such light minerals that were present. Bromoform, with a specific gravity of 2.89, was used as the heavy liquid. The weight of the light fraction was recorded. About 3 grams of the heavy fraction was taken for semi-quantitative spectrographic analyses, as a routine means of indicating the elements present. The remainder of the fraction was used for mineralogical study, and for grain counting to estimate the percentages of the various minerals. It was separated with an electromagnetic separator into four products of varying magnetic susceptibilities and a non-magnetic product. These products were examined microscopically and the minerals comprising them were segregated and identified. Grain counting was done to obtain an estimate of the percentages of the minerals in each of the products.

RESULTS OF INVESTIGATION

After removing the strongly magnetic material, chiefly magnetite and particles of iron, from the field concentrates with a hand-magnet, and separating the remainder with a heavy liquid, it was found that the heavy-mineral fraction in all but one of the samples examined contained at least 10 per cent ilmenite and hematite. The iron-bearing minerals were most prevalent in samples from the Carron Point, Red Bank, Newcastle, Champlain Heights, East Saint John, and Lepreau River areas, all in New Brunswick (see tables). Garnet was found to be the next most common mineral of possible economic interest, although its usefulness as an abrasive as it is found in sands is doubtful. Most of the garnet was less than 1/4 millimetre in diameter and it was mostly subangular to rounded in shape. Garnet was found to make up more than 10 per cent of the heavy minerals, by volume, in about one third of the samples examined. Garnet concentrations were observed as reddish streaks at a small beach near Lower East Pubnico. Amphibole, pyroxene, and epidote were common in the heavy minerals of most of the samples.

Of the rarer minerals, zircon was the most abundant. Samples from Big Hole Indian Reservation and Woodstock, New Brunswick, and Cole Harbour and Middleton, Nova Scotia contained more than 1 but less than 10 per cent zircon, by volume, in the heavy-mineral concentrates.

More than 1 but less than 10 per cent, by volume, of rutile was found in samples from Big Hole Reservation, Tracy, Lepreau River, and Penobsquis, New Brunswick. Composite grains of brookite and rutile were also found in the same percentage range in the sample from Penobsquis. Less than 1 per cent each of zircon, rutile, anatase and rutile, and anatase and zircon was found in many of the samples. Still less monazite, scheelite, pyrite, siderite, and goethite were found in some of the samples.

A sample from a small, locally derived beach at Cunard Cove, The Ovens, Lunenburg county, Nova Scotia, consisting chiefly of pyrite and arsenopyrite, was found to contain several small grains of gold. Malcolm (1929) stated that about 2,000 ounces were produced from this beach in 1861 and 1862.

Tables

More detailed results of the examination of samples are recorded in the tables that follow. On the left-hand page is a description of the location from which the sample was taken. On the right-hand page the numbers under the heading "Per cent Conc'n." express the percentages the field concentrates were of the original samples from which the concentrates were made. The next column shows the percentages, by weight, of total heavy minerals in the field concentrates, as determined by heavy-liquid separation. The third column shows the percentages, by weight, of the strongly magnetic minerals in the heavy-mineral fraction. The last three columns show minerals of possible economic interest that were identified in the heavy-mineral fraction. These columns show percentages, by volume, of the heavy-mineral fraction as determined by grain counting. Rock-forming minerals such as pyroxene, amphibole, olivine, and epidote have not been included in the tables, nor have many of the composite grains with the exception of anatase and rutile, anatase and zircon, and brookite and rutile compounds. Because of the similarity of hematite and ilmenite as found in sands, their percentages have not been listed separately.

CONCLUSIONS

None of the unconsolidated deposits of sand and gravel studied in New Brunswick, Nova Scotia, and Prince Edward Island appeared to contain sufficient quantities of heavy minerals to be workable under current marketing conditions, but small quantities of minerals that would be of economic interest in large deposits were found, and extensive sand and gravel deposits were seen. Because most if not all of these are post-glacial, there has been a relatively short time for concentrations of heavy minerals to be effected, as compared with areas where glaciation has not taken place. Glaciation appears to have destroyed, or glacial deposits to have covered, any concentrations that may have existed prior to glaciation. The deposits most likely to contain heavy-mineral concentrates of commercial interest are those formed from re-worked glacial material, or recent deposits such as the beach at Cunard Cove, mentioned previously. Because of the limited time available it was not possible to examine all sand and gravel deposits in the area, nor to examine in detail all the field concentrates that were obtained. The concentrates that were examined were selected so as to represent all types of unconsolidated deposits, according to nature, source rock, and so far as possible, distribution.

A drawback to prospecting of this kind, by individuals or companies, seems to be its specialized nature and the amount of laboratory work involved; few of the minerals concerned can be identified readily in the field when in small grains. At the least, it appears that many spectrographic analyses would be required, and much additional work by a qualified mineralogist would probably be necessary. It is doubtful if any government agency that assays samples or identifies specimens for prospectors on a limited basis would perform such services on the scale required for investigations of this kind.

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Location
New Brunswick
About 3 miles north of Bathurst, near southeast end of Youghal beach. Sample from 5-6 ft. from surface, 20 ft. inshore from crest of beach.
About 1/2 mile northeast from end of Carron Point road, 4 miles northeast of East Bathurst. Sample from 100 ft. inshore from crest of beach, taken from surface to 1.5 ft.
Big Hole Indian Reservation, 5 miles north of Redbank, on logging road 1 mile east of Northwest Miramichi River. Composite sample from 3 auger holes spaced 10 ft. apart, sample from 1.5-4 ft. below surface.
West side of Northwest Miramichi River about 1/2 mile above bridge at Red Bank. Sample from 6-8 ft. below surface.
From natural black-sand concentrate along northwest bank of Miramichi River, 1 1/2 miles above Newcastle. Sample from surface to 3 inches.
Sand pit in what is probably a floodplain deposit on the south side of Kennebecasis River near the village of Penobsquis. Sample taken from 2-4 ft. below surface.
Beach 3/4 mile west of Sheldon Point and about 3 miles southwest of Reversing Falls bridge at Saint John. Sample from just below high-tide level on the beach from surface to 1 ft.

Per cent Conc'n.	Per cent Heavy Minerals	Per cent Hand-magnetics	Minerals Identified		
			More than 10 %	10-1 %	Less than 1 %
0.65	33	5.7	ilmenite and hematite		garnet zircon rutile monazite
0.87	66.4	8.3	ilmenite and hematite		garnet zircon
0.83	64.2	18.7	ilmenite and hematite garnet	zircon rutile	
0.28	82.4	53.6	ilmenite and hematite	garnet	zircon rutile goethite
14.7	75	98	ilmenite and hematite	garnet	zircon rutile monazite
0.85	33.3	3.3	ilmenite and hematite garnet	brookite plus rutile rutile	zircon
1.4	47.7	9.4	ilmenite and hematite		garnet anatase plus rutile zircon

Location

New Brunswick, cont'd.

Beach at Mispec about 5 miles southeast of Saint John. Sample from just above high-tide level from surface to 2 ft.

Large sand and gravel pit east of Champlain Heights housing development and 1/4 mile south of highway No. 29 about 3 miles east of Saint John. Sample taken across 2 ft. from near bottom of pit, about 30 ft. from surface.

Beach of Jos. A. Likely Ltd., East Saint John harbour. Sample from surface to 1.5 ft. about 50 ft. down the slope of the beach from high-tide level.

Sand and gravel pit on south side of highway No. 1 about 1 mile east of Lepreau River. Sample from 2-4 ft. below surface.

Oak Point beach, about 18 miles north of Saint John on the west side of Saint John River. Sample from surface to 2 ft. from southeast end of beach.

Sand pit on south side of highway No. 8 about 6 miles southwest of Doaktown. Sample from 3-4.5 ft. below surface.

Sand and gravel pit about 1 mile north of Marysville on east side of highway No. 8. Sample taken across 2 ft. at bottom of pit.

Per cent Conc'n.	Per cent Heavy Minerals	Per cent Hand-magnetics	Minerals Identified		
			More than 10 %	10 - 1%	Less than 1 %
1.4	56.2	8.9	ilmenite and hematite		garnet anatase plus rutile zircon siderite
1.4	69.5	31	ilmenite and hematite garnet		rutile zircon monazite
1.35	77	28	ilmenite and hematite	garnet	zircon rutile anatase plus rutile
0.31	59	27.5	ilmenite and hematite	garnet rutile	zircon
2.1	50.7	3.1	ilmenite and hematite		garnet rutile zircon
1.3	33	30	ilmenite and hematite	garnet	rutile zircon scheelite pyrite
0.44	37.9	7.9	ilmenite and hematite garnet		rutile zircon monazite pyrite

Location
New Brunswick, cont'd. Sand pit on east side of highway No. 28 about 6 miles north of Tracy. Sample from 1 ft. to 4 ft. below surface.
Southwestern corner of Island Park, Woodstock. Sample of sand from surface to 6 inches, which overlies silt and fine-grained sand.
Flood-plain deposit on west side of Saint John River, 5 miles below Andover. Sample from 3-6 ft. from surface at edge of the river.
Sand and gravel pit about 1 mile south of Kilburn, near railway crossing on old highway No. 2. Sample of sand taken from 4-10 ft. from surface.
Gravel pit about 6 miles north of Plaster Rock on highway No. 23, on northwest side of Tobique River. Sample taken across 3 ft. at bottom of the pit near south end.
Sand pit east of radio tower at Edmundston. Sample across 8-inch sand bed in silt about 4 ft. below surface.
Gravel pit with sand lenses about 1 mile north of Caron Brook village. Sample from sand 4-6 ft. below surface.
Nova Scotia Cole Harbour beach, about 9 miles east of Halifax. Sample from surface to 2 ft. just above high-tide level.
Recent beach at Cunard Cove, The Ovens, about 7 miles south of Lunenburg. Selected sample from just above bedrock.

Per cent Conc'n.	Per cent Heavy Minerals	Per cent Hand-magnetics	Minerals Identified: More than 10 %	Minerals Identified: 10-1 %	Minerals Identified: Less than 1 %
0.94	33.6	13.7	ilmenite and hematite garnet	rutile	zircon monazite
0.29	54.6	8.7	ilmenite and hematite garnet	zircon	
0.41	71.8	15.1	ilmenite and hematite	garnet	zircon rutile
0.27	41.8	9	ilmenite and hematite	garnet	rutile zircon scheelite
0.65	57.2	3	ilmenite and hematite	garnet	zircon rutile plus anatase rutile
0.33	56	1.6	ilmenite and hematite	garnet	zircon rutile monazite
0.54	69.5	15.5	ilmenite and hematite	garnet	zircon rutile
0.54	45.3	13.8	ilmenite and hematite	garnet zircon	rutile anatase plus zircon
0.44	61.4	2.6	arsenopyrite pyrite		scheelite gold

Location

Nova Scotia, cont'd.

Beach near Petite Riviere Bridge, about 12 miles south of Bridgewater. Sample from surface to 4 ft. about 60 ft. backshore from high-tide level. Sand is chiefly quartz.

Lockeport beach. Predominantly quartz sand. Sample from surface to 1 ft. just above high-tide level.

Small sand beach at Lower East Pubnico. Reddish concentrations of garnet were seen on this beach. Sample taken across 6-inch width at surface just above high-tide level.

Beach at Beliveau Cove, St. Mary's Bay. Sand beach is about 600 ft. long, 15 ft. wide, and 1 ft. deep. Sample from surface to 1 ft.

Beach south of wharf at Pembroke, about 3 miles north of Yarmouth. Sand covers an area about 300 ft. by 40 ft. Sample from surface to 1 ft. just below high-tide level.

Small sand pit 0.8 mile north of highway No. 1 on gravel road about 6 miles east of Middleton. Sample from 2-9 ft. below surface.

Sinuous sand deposit that may be a former beach, about 1 mile east of Kingston, and continuous for about 1 1/2 miles. Sample from 2-4 ft. from surface from pit near west end of deposit.

Per cent Conc'n.	Per cent Heavy Minerals	Per cent Hand-magnetics	Minerals Identified		
			More than 10 %	10-1 %	Less than 1 %
0.05	78.6	0.5	ilmenite and hematite garnet		zircon anatase plus zircon anatase plus rutile rutile
0.09	27.3	4.4	ilmenite and hematite garnet		zircon
3.3	92.4	7.9	ilmenite and hematite garnet		rutile zircon
0.22	84.4	3	ilmenite and hematite	garnet	zircon rutile anatase plus zircon pyrite
0.58	42.4	8.1	garnet ilmenite and hematite		rutile pyrite zircon
0.78	65.6	6.1	ilmenite and hematite garnet	zircon	anatase plus zircon rutile brookite plus rutile
0.98	59	2.1	ilmenite and hematite	garnet	zircon rutile monazite anatase plus zircon

Location
Nova Scotia, cont'd. Sand and gravel pit about 1/2 mile south of property of Annapolis Valley Peat Moss Co. Ltd. at Aylesford. Sampled across 2-ft. sand bed about 3 ft. below surface.
Road-cut on Lovett road, 0.7 mile north of Coldbrook Station, and about 4 miles west of Kentville. Sample from 2-4 ft. below surface.
Beach about 300 ft. wide and 100 ft. long at Kingsport, about 5 miles north of Wolfville. Sample from surface to 1 ft. at high-tide level.
Mid-bay bar at Aspy Bay, Cape Breton. Sand is at north end of the beach; southern and western parts are chiefly cobbles and gravel. Sample from surface to 1 ft. near high-tide level about 1/4 mile from north end of beach.
Prince Edward Island Island Cavendish beach, 20 miles northwest of Summerside. Beach and dune are about 300 ft. wide. Sample composed of sand from crest of dune, foot of dune on sea side, and near high-tide mark. Similar sand is found for several miles along the north shore of Prince Edward Island.

Per cent Conc'n.	Per cent Heavy Minerals	Per cent Hand-magnetics	Minerals Identified		
			More than 10 %	10-1 %	Less than 1 %
0.5	59.2	2.1	ilmenite and hematite	garnet	zircon anatase plus zircon rutile
0.71	71.5	3.3	ilmenite and hematite	garnet	rutile zircon anatase plus zircon
0.20	64.8	2.2	ilmenite and hematite	garnet	zircon anatase plus rutile monazite rutile
0.63	64.7	12.6	ilmenite and hematite	garnet	rutile scheelite zircon pyrite
0.05	63	1.3	ilmenite and hematite garnet		zircon rutile monazite