Investigation of Beach Sands

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Beach sands at Florencia (Wreck) Bay, Cape Caution, and northeastern Graham Island were investigated during the 1957 field season in order to determine their magnetite content.

Samples were taken, using a hand-auger. Magnetite was separated by means of a low-power magnet, and zircon was separated by a Franz isodynamic separator. No attempt was made to estimate the gold content of any sample.

BLACK SAND AT FLORENCIA (WRECK) BAY (48° 125° N.W.)*

Florencia (Wreck) Bay is on the west coast of Vancouver Island about 4 miles northwest of Ucluelet. It is most conveniently reached from a branch of the Long Beach road that leads to the north end of the bay. The bay is crescent shaped and about 2½ miles long, between the two rocky headlands of Quisitis and Wya Points.

The beach has a very gently sloping foreshore which at low tide exposes a width of about 500 feet. The backshore zone is a tangled mass of driftwood partly buried in sand to unknown depth. Immediately back of the backshore zone, cliffs rise to an extensive flat about 100 feet above sea-level that extends eastward to Kennedy Lake. The materials exposed along the cliffs and cutbanks are Pleistocene till and outwash sands and gravels.

The beach material is plainly derived from the erosion of the till, sand and gravel. At the north end the beach is mostly sand, but to the south it contains progressively more gravel and cobbles. Presumably the beach is underlain at comparatively shallow but unknown depth by glacial till which is exposed at the base of some of the cutbanks.

Auriferous beach placers at Florencia Bay have been worked sporadically since 1899. It has also been known that there is a concentration of magnetite in the beach material.

Samples were taken with a hand-auger at 10-foot intervals along two lines at right angles to the beach. One line is near the northwestern end of the beach, at the foot of the trail leading down from the end of the road. The second line is 200 feet west of Lost Shoe Creek, about 1,800 feet southeast from the first.

The samples show that the highest content of magnetite and the greatest amount of concentration is in the upper foreshore zone. It is a zone about 50 feet wide extending seaward from the high-tide line.

The sample results are listed in the following tabulation:—

Distance from Bank	No. 1 Line (At foot of trail, northwest end of beach.)		No. 2 Line (1,800 feet southeast of No. 1 and 200 feet west of Lost Shoe Creek.)	
	Depth	Magnetite Content	Depth	Magnetite Content
	Inches	Per Cent	Inches	Per Cent
40 feet	10	4.18	...	.....
50 ,,	14	3.82	40	2.93
60 ,,	16	2.10	30	3.63
70 ,,	18	1.40	24	4.16
80 ,,	14	1.66	16	2.00
90 ,,	15	1.00	18	0.99
100 ,,	16	0.57	18	1.35
110 ,,	12	0.56	12	0.52
120 ,,	12	1.47	12	0.96

[Reference: Special Report on Wreck Bay by J. S. Stevenson, 1936.]

* By Stuart S. Holland.

BLACK SAND AT CAPE CAUTION (51° 127° S.W.)*

Concentrations of magnetite in beaches near Cape Caution were discovered some years ago by G. K. Storey, of Port Hardy. In August, 1956, application for a special placer-mining lease was made by A. G. Karop, of Qualicum Bay, to cover a beach on the mainland coast 4½ miles southeast of Cape Caution. Cape Caution is about 35 miles northwest of Port Hardy.

The beach is on the mainland, its northern end being about 4½ miles southeast of Cape Caution. It is about 2 miles long and lies between the rocky headlands of Raynor Point and Buccleugh Point. Quartz diorite outcrops at the northern end of the beach and rises in bluffs immediately back of the backshore zone. Bedrock outcrops for about 2,500 feet south of the northern end of the beach. No rock outcrops southward from there, and a low bench of about 400 acres extends eastward from the backshore area. At the southern end, quartz diorite outcrops extend southward to Buccleugh Point.

The beach faces southwest and is fully exposed to the open ocean. It is subjected to numerous storms, and as a consequence the backshore zone has a crisscrossed accumulation of driftwood, part of which is buried in sand to unknown depth.

A landing was made on the beach on June 23rd for the purpose of sampling the beach sands. Samples were taken by hand-auger along five lines, at right angles to the beach, 1,000 feet apart. The first line of sample holes is at the extreme north end of the beach. Visual examination of the sands shows them to contain most magnetite at the north end of the beach; this is also apparent from the sample results. It was not considered necessary to sample farther south than the last line of samples because the beach material by visual examination has essentially the same magnetite content as in Line No. 5.

Spectrochemical analyses show that the titanium content is approximately 10 per cent that of the iron. The sampling results are summarized in the following table. The first sample in each row was taken at the western edge of the accumulation of driftwood, which, for the most part, was 50 to 100 feet wide.

Distance from West Edge of Backshore	No. 1 Line		No. 2 Line (1,000 feet south.)		No. 3 Line (2,000 feet south.)		No. 4 Line (3,000 feet south.)		No. 5 Line (4,000 feet south.)	
	Depth of Sample	Magnetite Content	Depth of Sample	Magnetite Content	Depth of Sample	Magnetite Content	Depth of Sample	Magnetite Content	Depth of Sample	Magnetite Content
	Inches	Per Cent	Inches	Per Cent	Inches	Per Cent	Inches	Per Cent	Inches	Per Cent
0 feet	31	7.04	33	4.36	28	0.91	26	1.46	30	1.39
+25 „	26	3.26	....	.....	....	.....	....	.....	....	
+50 „	20	1.03	27	5.40	....	.....	18	0.79	18	0.80
+75 „	18	0.78	22	2.18	29	1.03	....	.....	....	....
+100 „	15	0.55	19	1.66	22	0.64	17	0.46	14	0.73
+150 „	16	0.68	13	0.69	15	0.30	13	0.18	....	....
+200 „	20	0.72	....	....	13	0.69	....	.....	....	....

GRAHAM ISLAND BEACH SANDS†

Extensive beaches along the northern and eastern coasts of Graham Island for a long time have been known in certain places to contain concentrations of placer gold and black sand. From time to time attempts at mining them for their placer-gold content have been made, but the operations have been financially unsuccessful. In 1956 and early 1957 interest in the beaches was renewed with a view to investigating them for their magnetite content.

An examination of the beach-sand occurrences was made by Stuart S. Holland and H. W. Nasmith between July 4th and 16th, at which time the stretch of beach between Blue Jacket Creek and Oeanda River was traversed. No samples were taken. A fraction

* By Stuart S. Holland.
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of the heavy minerals separated from each of the company samples was provided by Mogul Mining Corporation Limited.

The section of Graham Island bounded by the Tlell–Port Clements road on the south and by Masset Inlet on the west forms a large part of the Northeastern Lowland topographic province defined by MacKenzie.* It is a low, gently undulating plain ranging in elevation from 150 to 250 feet, from which rise a few flat-topped hills to a maximum elevation of 535 feet. Bedrock is exposed at only a few localities—Skonun Point, Yakan Point, and Tow Hill (elevation, 425 feet) on the north coast. At Skonun Point three lignitic coal layers 2 to 3 feet thick, striking north 80 degrees west and dipping 50 degrees south, outcrop in the core of an asymmetrical anticline and are overlain by fossiliferous sandstones and pebble conglomerates of Miocene age.† At Yakan Point soft shales and fine-grained sandstone dip 5 to 10 degrees east. Some of the sandstone beds that are exposed at low tide contain well-preserved fossil leaves. Tow Hill is the one prominent topographic feature of the northeast beaches. It consists of basalt with well-developed steep columnar jointing overlying soft grey shales of the Skonun formation dipping about 5 degrees west. Argonaut Hill (elevation, 535 feet) and other hills within the lowland are probably underlain by bedrock, but for the most part the character of the subsoil is concealed by a dense growth of forest or muskeg vegetation.

Although the northeastern tip of Graham Island between Masset Sound and the east coast may be underlain by the Tertiary Skonun formation, it is very largely covered by unconsolidated Pleistocene sediments. Exposures along the east coast, along Masset Inlet, and in road cuts along the Masset–Port Clements road show that the Pleistocene sequence consists of marine clays and sands which grade upward into outwash sands and gravel, overlain at the surface by a thin mantle of basal till on which forest soils and muskeg deposits have formed. The post-glacial beaches were the subject of the present examination, and the glacial deposits were only briefly examined.

G. M. Dawson noted the presence of striations trending north 10 degrees west on small islands west of the entrance to Masset Inlet. Air photos show prominent lineations with a similar trend south and east of these islands, and it is thought that the lineations were impressed on the glacial till overlying the sands and gravels and that they show the direction of movement of the last major glaciation. These lineations, when plotted, show that the ice moved northwestward across the northeastern part of Graham Island, possibly from a glacier in Hecate Strait, and presumably joined ice from Alaskan and mainland glaciers, which flowed westerly through Dixon Entrance beyond Langara Island.

Prominent post-glacial beaches have been developed along the north and east coasts of the northeastern part of Graham Island. None is more than about 30 feet above present sea-level, although sand dunes on the beaches have been built to considerably higher levels. No post-glacial beaches above present sea-level are recognized on the air photos of the lowland.

Masset Sound is probably a drowned river channel. It was carved at a time when sea-level was about 75 feet lower than at present and after the last major ice-sheet had retreated. It is possible that it may have been carved during a period of local glaciation when glaciers from the mainland did not reach Graham Island. Beaches which were developed during such a low stand of sea-level would at present be submerged beneath as much as 75 feet of water.

The beaches along the northern and eastern coasts are a remarkable feature of Graham Island. Except for the bedrock at Skonun Point, Yakan Point, and Tow Hill, the entire distance between Entry Point and Rose Spit, a distance of 26 miles, is continuous wide sandy beach. The foreshore is wide, 500 feet or more, because of the combination of gentle slope and wide tidal range. The backshore area, which may be several

* *Geol. Surv., Canada*, Mem. 88, p. 29.
† *Geol. Surv., Canada*, Mem. 88, p. 75.

hundred feet or more in width, abuts a succession of sand dunes, elongated parallel to the shoreline.

Prominent beaches extend down the east coast from Rose Spit to Tlell, a distance of 43 miles. To the mouth of Oeanda River, 16 miles south of Rose Spit, the foreshore area is steeper and narrower than on the north coast and the material appears more gravelly. Northwesterly trending sand dunes extend for several hundred feet back from the backshore. No bedrock outcrops between Oeanda River and Rose Spit. Low cliffs (cutbanks) of unconsolidated Pleistocene material extend southward from Fife Point.

Studies of air photos clearly indicate that the beaches of the east coast are being eroded, and that those of the north coast are depositional and have advanced as much as a mile from the line along which they were initiated. Rose Spit appears to have started at the base of Argonaut Hill and to have grown northward to its present position, possibly in more than one stage. Some of the beach deposits which formed at an early stage of the spit have been eroded along the east coast and redeposited as the spit was built northward.

Wave and current action on the east coast is transporting material northward to Rose Spit, thence westward along the north coast toward Masset Inlet. At points of active erosion, concentration of heavy minerals may take place; these are especially noticeable at several points along the east coast. The north coast, being depositional, lacks concentrations of heavy minerals, except in two places where local erosion and concentration are being effected.

The full extent of erosion along the east coast is not known. Nevertheless, features shown on the air photos show that the Oeanda River formerly meandered along a much broader flood plain, which has been eroded by wave action. The course of the river has been gradually diverted to the western edge of the flood plain by sand dunes building inland as beach erosion progresses.

Beaches along the east side of Masset Sound, which was a Pleistocene river valley when the sea-level was lower, are steep, narrow, and bouldery. Sand is very largely absent, except from Blue Jacket Creek northwards.

The sand of the north and east coast beaches clearly is derived from Pleistocene deposits which have been eroded by wave action along the east coast south of Argonaut Hill. In places, pebbles on the north coast beaches are derived by erosion from outcroppings of Tertiary formations at Skonun Point, Yakan Point, and Tow Hill. The Pleistocene deposits were probably derived in part from Tertiary sediments and volcanics of Graham Island, but part of the material no doubt comes from more distant sources.

For at least eighty years the beach sands have been known to contain magnetite and gold.* Numerous unsuccessful attempts have been made to mine the beach sands for their gold content. Placer-mining took place at Cape Fife, along a 3-mile stretch of beach 5 miles south of Cape Fife, along a stretch south of the mouth of Oeanda River, and in a small area at the mouth of Blue Jacket Creek a mile south of Masset. These are areas where there has been a concentration of magnetite in the normal sand into lenses possibly a few inches thick (from 1 to 8 inches normally), a few tens of feet wide, and possibly 500 or more feet long. The lenses might possibly average 50 per cent magnetite, and consequently represent a fairly high ratio of concentration of the normal beach sand. The small amount of placer gold the lenses contained was never sufficient to support a profitable operation other than for a few individuals.

In 1956 interest was taken in the beach materials as a possible source of magnetite. As a result of application, special placer-mining leases were granted in June, 1957, to Mogul Mining Corporation Limited of Toronto, Utah Co. of the Americas, and Westport Chemical Company of Seattle.

The special placer-mining lease issued to C. H. Donaldson, who was acting for Mogul Mining Corporation, covers about 34,672 acres and extends along the north coast of Graham Island from Masset Inlet eastward to a point 4½ miles from the tip of Rose

* *Geol. Surv., Canada*, Ann. Rept., 1878, p. 33B.

Spit, thence south to a point on the east coast about 12 miles south of the tip of Rose Spit, thence along the coast for 5 miles. It includes also 4½ miles of beach lying about 4 miles south of the mouth of Oeanda River.

C. H. Donaldson set up camp at Limberlost, on the north coast, 7 miles east of Masset. Extensive drilling by jetting machine, churn drill, and hand-auger was done to explore and sample materials of potential value. A laboratory was set up to process the samples and to determine their heavy mineral and magnetite content.

Samples from the drilling were sereened through a ¼-inch screen and reduced by Jones riffle to 20 pounds in weight. Punch samples of these were taken in the laboratory, dried, weighed, screened through 10 mesh, and reduced by Jones riffle to about 100 grams. This sample was put into a separating funnel with tetrabromoethane (specific gravity 2.95) and the heavy minerals separated and drawn off. The heavy mineral content, which included magnetite, hematite and ilmenite, garnet, altered silicates, hornblende, epidote, zircon, titanite, and rutile, was measured directly. A grain count of the heavy minerals from each sample was made later.

Drilling and sampling by the company was done in three areas—around Blue Jacket Creek, along the north coast, and along the east coast.

In the Blue Jacket area, grid lines were laid out at 300-foot intervals and hand-auger holes were drilled every 300 feet. A total of ninety-eight holes, having an average depth of about 8 feet, was drilled. The heavy mineral content was found to be extremely variable, ranging from 1 or 2 per cent to as much as 40 to 50 per cent in a few instances. An area of concentration was found around Blue Jacket Creek where the company estimates that to a depth of 8 feet there are about 685,000 cubic yards of material averaging about 15 per cent heavy minerals. Samples of heavy-mineral concentrates were examined, and the magnetite content was found to be 4 to 6 per cent of the heavy minerals, or 0.6 to 0.9 per cent of the original sand.

A sample of beach sand from the Blue Jacket area sent to the Mines Branch in Ottawa for mineralogical determination had the following content: Magnetite, 23.9 per cent; hematite and ilmenite, 38.8 per cent; garnet, 15.0 per cent; quartz and feldspar, 11.2 per cent; altered silicates, 3.6 per cent; hornblende, 3.0 per cent; epidote, 2.0 per cent; zircon, 1.2 per cent; staurolite, 0.9 per cent; titanite, 0.3 per cent; and rutile, 0.1 per cent. This sample is of interest in showing the minerals present, but, being a beach sand, it has been concentrated an unknown amount.

Sampling of material along the north coast was done by twenty-six churn-drill holes totalling 1,407 feet and forty-five auger holes totalling 402 feet. The holes, for the most part, were drilled close to the Tow Hill road, ranging from a few hundreds to about 2,000 feet south of the coastline. The materials penetrated and sampled by the drill-holes were dune sand in the upper parts of the holes and beach sand at varying depths below sea-level.

In the churn-drill holes the heavy mineral content ranged from 2 per cent to as much as 35 per cent and averaged 6.6 per cent. The magnetite content of the original sand ranged from 0.2 to 2.4 per cent and averaged 0.6 per cent. The hand-auger holes showed the heavy-mineral content to be less than 10 per cent and the magnetite content to be less than 0.5 per cent.

Testing on the east coast was done in two areas—one a 5-mile stretch of beach extending north of the mouth of Oeanda River to Clearwater Lake, and a 4½-mile stretch of beach lying about 4 miles south of the mouth of the Oeanda River.

In the southern area, nine hand-auger holes totalling 283 feet were put down at half-mile intervals. The heavy-mineral content of the material sampled averaged 3.8 per cent.

In the northern area, forty-eight grid lines 200 yards apart were laid out and hand-auger holes were put down at 100-yard intervals back from the beach. The material sampled was dune sand containing about 11 per cent heavy minerals. Examination and testing of the heavy-mineral fraction showed a magnetite content averaging 6.3 per cent and a zircon content averaging about 0.5 per cent. The original dune material conse-

quently averages about 0.7 per cent magnetite and about 0.055 per cent zircon. No monazite was detected.

In places along the foreshore, heavy minerals have been concentrated by wave and current action into lenses as much as 6 inches thick, a few tens of feet wide, and a few hundred feet long. Samples of such material have a magnetite content averaging about 23 per cent and a zircon content of about 1.2 per cent.

Mineralogical study of the heavy-mineral fractions obtained from the sands indicates that the rutile and free ilmenite content is extremely low, and that the titanium occurs as ferriferous ilmenite and titanhematite. For example, a sample containing 79.7 per cent material with a specific gravity higher than 3.6, on analysis, was found to contain: Magnetite, 18.8 per cent; hematite and ilmenite, 33.0 per cent; garnet and staurolite, 26.8 per cent; zircon and rutile, 1.0 per cent; and titanite, 0.1 per cent. Further examination of the hematite-ilmenite fraction showed: Hematite, 46 per cent; ilmenite, 6 per cent; hematite with lamellæ of exsolved ilmenite, 40 per cent; and ilmenite and hematite intergrown in about equal proportions, 7 per cent.

The Utah Co. of the Americas was granted a lease in 1957 on about 12.6 square miles, which included the beach stretching southward from Rose Spit for about 12 miles. No systematic testing of this ground was done by the company.

The Westport Chemical Company, of Seattle, was granted a lease in 1957 extending along the east coast of Graham Island for about 4 miles south of the mouth of Oeanda River. The company was interested in the sands as a possible source of titanium. A bulk sample of material was taken out for testing, but when it was discovered that the rutile content was extremely low and that the ilmenite occurred as an ilmenite-hematite intergrowth, testing was discontinued.

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