STATE OF OREGON

DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

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G M I SHORT PAPER

SOME DATA ON BLACK SAND INVESTIGATIONS

PRICE 10 CENTS

DATA ON BLACK SAND INVESTIGATIONS

The black sands of the Oregon coastal area represent the hard and more resistant minerals left from the disintegration and erosion of the basic igneous rocks of the ferromagnesian type. These sands are found as present beaches and as ancient beaches in a narrow strip in the coastal beaches and terraces. They vary considerably in size and shape and occur in a widely distributed area, as shown by the general map on page 2.

The commercial possibilities of the black sands have been considered for many years. As early as 1853 Professor W. P. Blake investigated the black sands of the Oregon coast. He was concerned principally with the gold and the platinum content of the sands. He found that platinum was present to the extent of 30% of the gold values, and also that part of the platinum could be picked up by the magnet.

The mineralogy of the sands was studied at various times following the original work of Professor Silliman in 1873. Table 1 gives the result of mineralogical studies carried out by Day and Richards 1/ of the U. S. Geological Survey in 1905. Magnetite sand concentrates, coke, and limestone were smelted and produced steel in October 1905 2/. Difficulties of the usual experimental sort were encountered; but in spite of the negative results, the process was proven as practicable.

Since these investigators, the sands have frequently been the subject of investigation for methods of economically extracting mainly gold and platinum. However, no commercial plant operating on a production basis has resulted from any of the work of the investigators up to this time.

The Oregon Department of Geology and Mineral Industries has felt that there are commercial possibilities in treating the sands for minerals other than gold and platinum. Chromite, ilmenite, magnetite, garnet, zircon, and olivine are known to be present in appreciable quantities in various of the coastal deposits, as may be noted by referring to Table 1. This Department, late in 1939, undertook an investigation including field studies and laboratory metallurgical tests in the hope of indicating the commercial possibilities of these deposits. Concentration of the materials by electrostatic, electromagnetic, and gravity methods was planned. Electrostatic concentration was first used, with the Ritter Products Company of Rochester, New York, performing the tests.

Samples of material (Table 2) were taken from the Pioneer Mine, in the Coos Bay district, and sent to Ritter for these tests. Table 3 presents screen and chemical analyses of the electrostatic products. A 90% recovery of chromic acid (chromic oxide, Cr_2O_3) was realized in the electrostatic concentrate. This concentrate, however, contains 13% magnetite which when eliminated will raise the chromic acid content to above 46%.

Table 1

MINERAL COMPOSITION OF BLACK SANDS:
Abstract from
"Useful Minerals in the Black Sands of the Pacific Slope"
D. T. Day and R. H. Richards
U.S.G.S. Mineral Resources of U.S., 1905, pp.1206-1214.

Locality	Magnetite	Chromite	Ilmenite	Olivine	Zircon
	(Percentage	referred to natural sand)			
Baker County:					
Anthony	8.4	-	-	-	1.5
Baker City	10.4	-	38.4	-	Tr.
Sumpter	10.4	-	43.2	-	Tr.
Clatsop County:					
Clatsop Beach	26.9	2.3	-	-	-
Hammond	14.2	-	6.2	-	-
Warrenton	56.2	12.8	-	16.8	.25
Hammond	59.3	7.2	-	9.2	.45
Warrenton	-	Tr.	-	23.0	.35
Hammond	3.1	1.2	-	28.2	Tr.
"	32.2	8.7	-	-	.25
"	34.2	8.1	-	-	.25
"	33.3	8.7	-	10.9	.3
Carnahan Sto.	Tr.	Tr.	-	19.0	Tr.
"	Tr.	Tr.	-	20.0	Tr.
Clatsop Spit	2.6	4.2	-	23.3	.2
Coos County:					
Marshfield	-	8.2	-	-	.6
S. Fk. Coquille R.	-	2.5	-	-	.6
Randolph Dist.	1.0	29.2	-	-	2.2
"	Tr.	10.1	-	11.0	.8
Whiskey River	-	11.2	.6	-	.9
Curry County:					
Chetco	76.0	14.2	-	5.5	.2
Port Orford	1.5	3.5	-	45.9	.2
Rogue River	43.3	5.3	-	39.0	.1
Josephine County:					
Waldo	-	1.1	-	-	1.4
Lincoln County:					
Yaquina	6.2	5.3	27.0	-	4.2
"	6.1	6.4	28.6	-	3.9
Newport	8.0	6.8	33.1	-	5.3
Multnomah County:					
Fulton	41.5	-	45.5	3.0	Tr.

Table 2

Department Screen Tests

1. Banks
2. Tailings below sluice.
3. Tailings near race.
4. Average bunker sample.

Screen Analysis

Mesh	on	1 %	1 % Cum.	2 %	2 % Cum.	3 %	3 % Cum.	4 %	4 % Cum.
Thru	48	6.6	6.6	7.3	7.3	8.2	8.2	15.8	15.8
48	65	27.9	34.5	27.2	34.5	25.5	33.7	32.0	47.8
65	100	50.0	84.5	52.8	87.3	52.3	86.0	44.5	92.3
100		15.5	100.0	12.7	100.0	14.0	100.0	7.7	100.0

Chromic Acid (Cr_2O_3) Analysis

Mesh Thru	on	%	% Total	%	% Total	%	% Total	%	% Total
	48	6.7	2.0						
48	65	13.8	17.4	20.2	21.2	17.5	19.3	17.7	25.0
65	100	20.4	46.5	27.4	56.1	25.9	58.7	28.3	55.5
100		28.8	19.2	29.5	14.5	29.3	17.8	27.2	9.3
Original		22.4		25.9		23.1		22.7	

Table 3

Ritter Investigation

Screen Analysis

On 30 mesh	1.4%	1st Tailing	32.1%
Thru 30 mesh	98.6%	2nd Tailing	18.5%
		Concentrate	49.4%

Chemical Analysis

Product	Cr_2O_3 %	(Cr) %	Al_2O_3 %	Fe %	SiO_2 %	P %	TiO_2 %	Assayed by:
1	22.4-	15.3-						Lazell
	25.9	17.7	27.22	12.6	18.8	.52	5.46	Department
2	21.8	14.9				.26		Department
3	3.8	2.6				.26		Department
4	5.0	3.4				.39		Department
5	39.8	27.2	2.6	19.6	5.4	.17	.48	Department, Charlton

1. Composite unconcentrated bank material, 4 Pioneer samples - about 150 lbs.each.
2. Electrostatic heads taken from No.1 and sent to Ritter for tests.
3. 1st electrostatic tailing, Ritter.
4. 2nd electrostatic tailing, Ritter.
5. Electrostatic concentrate, Ritter.

FIELD SAMPLING

Two members of the Department with a truck visited various localities from Newport beach south to the Oregon-California line, a distance of approximately 230 miles, and obtained samples both from the present ocean beaches and from the so-called back-beach deposits. (See map page 5 for general location of these samples.) Below are descriptions of the various samples taken.

#1. Yaquina Beach. Sample consists of present beach sand from a pit, 2 feet deep, located 500 feet north of shore end of breakwater. The beach is approximately 200 feet wide by 600-800 feet long and extends some distance up the river. These shore deposits do not contain much black sand. Panning shows about 5% content of black sand.

#2. Sample of dune sand taken 1.5 miles north of Tahkenitch Lake at U.S.Bench Mark 5G12. These sands may be a possible source of silica or glass sands. The sample location is 10.00 miles north of the north end of the Umpqua River bridge and on the west side of the highway.

#3. The Lagoons (north of Bandon). Sample taken from material removed from a test-pit just in front of the cabins. Test-pit was apparently in black sand lens from top to bottom. Extent of lens not known, but it is thought to be tailings from placer mines up the creek.

#4. Whiskey Run Creek. Sample of beach sands at mouth of Whiskey Run Creek. Sample represents surface section of beach normal to shoreline. This sample does not contain much black sand.

#5. U. S. Mining Co. (Ohlmstead). Located north of the Pioneer Mine. The sample was taken from a well-cemented lens of at least 20 inches in thickness. The lens has considerable extent but is overlain by from 10 to 30 feet of overburden. Overburden is also firmly cemented. This channel (6" wide x 5' long) sample was taken in main pit just east of mine shed.

#6. Chickamin Mine (South Slough). Channel sample 8 feet long by 6 inches wide in lens of cemented black sands. The entire thickness of lens not exposed. A 35-foot tunnel follows the dip of the lens. A 35-foot hole was reported to have been drilled from the face of the tunnel without leaving the lens. There is an excellent possibility that this lens is extensive and croppings might be located by following the hill slopes in either direction from the tunnel. Excellent prospects for large tonnage.

Across the valley (to the north) is an old placer mine. The cemented lens, described in above paragraph, thins and peters out on the north side. Small boats (2' draft) can approach, by south slough, to within 1000 feet of this location. A channel could be dredged to the prospect at no large expense. A dike across the valley prevents water from backing into the valley at high tide. Location is 2.06 miles from junction on Seven Devils Road where the car must be left. Take left hand turn after crossing bridge and continue beyond school house 1/4 mile. Trail leads down hill to valley. Main tunnel (sampled) is almost directly across valley from old placer workings and approximately 75 feet above valley floor.

#7. Butler Mine. 1.5 miles north of the Madden Mine on the highway. A small area (less than 100 feet across) has not been mined. The area may contain continuations of this lens, especially on west side of highway. Old workings are on east side of highway and old plant on west side.

#8. Madden Mine. Sample was collected from channels in three sections representing a thickness of 19 feet. Samples marked: top, 5 ft.; middle, 7 ft.; and bottom, 7 ft. One sack of test material was taken from lens (5 ft. thick) 30 feet west of bridge at entrance to pit. Also a sample (channel 5 ft. long) from same lens.

#9. Cape Blanco. Mr. Marshall, Port Orford, Oregon, has a small gold recovery outfit at Cape Blanco. Handling 6 yard/day, 52% gold recovery. Three samples collected here. One of beach sands about 1/2 mile south of Marshall's set-up. Another sample of beach sands at the set-up, and a sample of concentrate that had passed through the sluices.

#10. Cape Blanoo Road. Sample collected from road cut just below cattle guard near end of main road. Lens 3 to 4 feet thick.

#11. Cape Blanco Road. 3 miles from main highway. Sample from lens, at least 7 feet thick, exposed by road cut. Lens has possibility of considerable extent.

#12. Humbug State Park entrance. Sample collected from beach on a line normal to the shoreline and just south of creek mouth.

#13. Hunter's Creek. This sample is mostly small gravel from south side of stream and just west of the south end of the bridge. Very little black sand present. Met Mr. J. H. Turner of Gold Beach, Oregon, who has a manganese prospect near Hunter's Creek.

#14. Myer's Creek. Sample taken near mouth of creek. Sands are not very black. The beach here has considerable extent on the north and the south of the creek.

#15. Windchuck Creek. Property of R. W. Lemon. Sands are not very black, can drive through Lemon ranch to beach.

#16. Mouth of Rogue River. Estate of MacCleay Beach sands are quite black. Sample taken parallel to beach and represents a considerable extent of black sand. Large tonnage available. One of the best areas visited.

Assays of the samples just described were made at the Grants Pass State Assay Laboratory. These assay results follow:

Sample Number	Description	Cr_2O_3 %	Sample Number	Description	Cr_2O_3 %
1	Beach	0.5	9A	1/2 mile south	24.3
3	Lagoons	21.2	9B	At set-up	13.3
4A	Sand	1.5	9C	Concentrate	21.3
4B	Lens	0.3	12	Sand	0.1
5A	Lens	22.3	13	Sand	0.5
5B	Concentrate	26.0	14	Sand	0.4
6A	Sand	4.2	15	Sand	0.1
6B	Concentrate	2.2	16A	Sand	0.7 Subject to
8A	Bottom 5'	2.0	16B	Concentrate	3.3 recheck
8B	Middle 7'	1.5			
8C	Top 7'	0.7			

A portion of sample 16 was taken to ascertain the magnetic content. A strong horseshoe magnet was used and magnetic material segregated and assayed. The magnetic product amounted to 10% by weight of the original sample material. Below are shown the assays of this magnetic portion of the sample:

Silica - 4.4% Phosphorus - .00% Titanium dioxide - 4.3% Iron - 56.7%

From iron assay and the titanium noted above, it is plain that the magnet removed some ilmenite, and probably some chromite as well, from the portion of the sample tested; so the material assayed does not represent a true magnetic product.

DETAILS OF ELECTROSTATIC TESTS

It should be stated that the reason the Department had given little attention to the coastal sands until 1939 was our knowledge that a considerable percentage of titanium was present in nearly all of the deposits. This element is objectionable in the blast furnace, and we were under the impression that it would so complicate the metallurgy that we would not be justified in investigating the sands. Claims had been made that the titanium minerals could not be separated by electrical means, for attempts to treat these coastal sands magnetically indicated unfavorable results. We decided to try electrostatic separation in the laboratory when the first result of electrostatic treatment of the materials by the Ritter people came in; since we noted that the titanium content had been reduced to less than 1/2 percent, we were considerably encouraged. The electrostatic products returned to us by the Ritter people indicated also that the first tailings product was largely garnet which might have commercial value.

The Department was able to borrow some electrostatic equipment. This was set up in Portland and was then used by Mr. Motz, Metallurgical Chemist of the Department, for further tests on some of the samples described above. Although many separate tests were made in order to try out various voltage adjustments and electrode gaps, no large number of products was retained for the reason that the work was largely of qualitative nature in an effort to determine the general adaptability of the method to the type of material. Visual inspection of the results in most cases was sufficient to supply an excellent clue to the work being done by the apparatus. Preliminary experiments with the machine included changing the electrode position, reversing polarities, etc.

Two methods of attack are possible: 1, take a clean tailing and a rougher concentrate in the first pass, and a middling from the rougher concentrate by another pass; or 2, make a clean concentrate and a rougher tailing in the first pass, and then take a clean tailing and a middling product from the rougher product. The first method is the one usually employed in concentration processes and proved the better in this instance.

Table 4 presents screen analyses and magnetic contents of the sands considered in this work.

Table 4

Mesh Thru	On	#3 %	#9A %	#9B %	#16 %
	35	7	5	24	1
35	48	18	21	32	15
48	65	26	29	23	45
65		49	45	21	39

Magnetite (% of original sand)

Sample		Trace	10	11	9
	35	-	-	2	
35	48	-	4	6	4
48	65	Trace	9	12	8
65		Trace	14	28	12

Sands may be concentrated by sizing on screens; the chromite concentrating in the smaller sizes. An example of this is given below with assays of screened portions from Sample #9A, 1/2 mile south of Marshall set-up, Cape Blanco:

Table 5

Sample 9A

Tyler Mesh Thru	on	Chromic Acid (Cr_2O_3) % Portion	% Total
	35	Trace	-
35	48	3.6	3
48	65	21.8	27
65		36.0	70

The -48+65-mesh material contains 27% of the Cr_2O_3 of the original sand. An electrostatic concentrate of this sized material assayed 36.1% Cr_2O_3 indicating a 55% recovery, or the concentrate contains 14.9% of the Cr_2O_3 in the sand. However, the -65 mesh material assayed 36.0% Cr_2O_3 which represents 70% of Cr_2O_3 in the original sand. No electrical separations were made on this mechanically concentrated material, although a very good concentrate may be made with low recovery. The -100 mesh material in these sands is of the order of only 4% to 6% of the original sand, and it is mainly magnetite.

CONCLUSIONS ON EXPERIMENTS

This investigation has shown that the unconsolidated black sands or beach material from the Oregon coastal areas are amenable to electrostatic separation. It is possible that concentration of the chromite and perhaps other desired minerals in these sands can be accomplished just as well by air tabling or electromagnetic separation as by electrostatic. It may be that a combination of two or more of these processes will be the ultimate answer to the metallurgy of these deposits. It appears that bank-run material, running from 10% to 25% chromic oxide can be treated easily and cheaply with the production of a relatively high-grade product running of the order of 40% to 45% chromic oxide. The silica content of the original material is diminished to a couple of percent in the final product; alumina is also cut down to 2% or 3%; phosphorus is reduced substantially. A garnet product with a relatively small content of quartz can probably be produced commercially if there is sufficient demand for that mineral as an abrasive. No special attention was given to the separation of zircon in these experiments although we are informed by a technician of the U.S. Bureau of Mines that a relatively clean zircon product as well as a clean ilmenite (titanium oxide source) product should be obtained by the electrostatic method.

It should be remembered that in the gravity separation and concentration of hard rock chromite ores, one of the chief costs is that of grinding. In the case of these Oregon coastal deposits, the raw material is ground by nature and fortunately classified to a size which is almost made-to-order for any electrical or gravity separation process. The screen tests indicate that 90% to 95% of the raw material is naturally classified to a minus-35 mesh and a plus-100 mesh size. The screening tests also show that by rejecting the plus-48 mesh immediately no great loss of chromite would be suffered as indicated by Tables 2 and 5. More than 95% of the chromite grains pass through a 48 mesh screen.

It should be noted that individual grains of these black sands have individual mineral identities. Grains are not commonly composed in part of one mineral and in part of another. This point is important in considering the adaptability of black sand to mineral separation as against the difficulty of concentration of crushed ores where the particles formed by fine grinding often contain an intimately interlocked mixture of desired and undesired minerals.

REFERENCES:

1/ D. T. Day and R. H. Richards: Useful Minerals in the Black Sands of the Pacific Slope; U.S.G.S. Mineral Resources of U.S., 1905.

2/ D. T. Day, C. E. Wilson, and G. H. Clevenger: Electric Smelting of Magnetite from Black Sands; U.S.G.S. Mineral Resources of U.S., 1905.