

Alaska

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Lead, Zinc
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R. I. 3967

NOVEMBER 1946

UNITED STATES
DEPARTMENT OF THE INTERIOR
J. A. KRUG, SECRETARY

BUREAU OF MINES
R. R. SAYERS, DIRECTOR

REPORT OF INVESTIGATIONS

EXPLORATION OF SEDANKA ZINC DEPOSIT

SEDANKA ISLAND, ALASKA

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BY

B. S. WEBBER, J. M. MOSS, AND F. A. RUTLEDGE

R. I. 3967,
November 1946.

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UNITED STATES DEPARTMENT OF THE INTERIOR -- BUREAU OF MINES

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By B. S. Webber,^{2/} J. M. Moss,^{3/} and F. A. Rutledge^{4/}

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INTRODUCTION

The United States, with its vast resources of relatively lowgrade zinc ores, has been the world's leading producer of zinc metal for many years. The expanded zinc production during the period, 1939-44, inclusive, was induced by favorable premium prices and has depleted the known ore reserves in the United States. The 1943-44 rate of zinc production can not long be maintained in the United States, especially if premium prices are removed. Domestic zinc reserves have been depleted to such an extent that it is doubtful if our mines will again be able to completely and continually fulfill the needs of this country.

The Bureau of Mines, anticipating a postwar consumer demand for 550,000 to 750,000 tons of slab zinc and an additional 100,000 tons for use in paints and chemicals, sent two engineers to Sedanka Island in July 1945 to investigate the deposits near Biorka Harbor.

^{1/} The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Report of Investigations 3967."

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ACKNOWLEDGMENTS

In its program of exploration of mineral deposits, the Bureau of Mines has as its primary objective the more effective utilization of our mineral resources to the end that they make the greatest possible contribution to national security and economy. It is the policy of the Bureau to publish the facts developed by each exploratory project as soon as practicable after its conclusion. The Mining Branch, Lowell B. Moon, chief, conducts preliminary examinations, performs the actual exploratory work, and prepares the final report. The Metallurgical Branch, R. G. Knickerbocker, chief, analyzes samples and performs beneficiation tests. Both these branches are under the supervision of Dr. R. S. Dean, assistant director.

The exploratory program of the Alaskan Division, Mining Branch, is under the direction of R. S. Sanford, acting division chief, Juneau, Alaska. Beneficiation tests on a composite sample representative of the Biorka ore were made at the Salt Lake City Experiment Station by the Metallurgical Branch, S. R. Zimmerley, chief, and test engineer T. F. Mitchell of the Salt Lake Division. Samples were submitted to the Territorial Assay Office, Ketchikan, Alaska, and was analyzed by Nils Johansson. The field examination was made by B. S. Webber and J. M. Moss, and the report was written by F. A. Rutledge.

Special acknowledgment is made of the assistance rendered by F. H. Lerchen and Harry Townsend, mining engineers. The Bureau of Mines is indebted for the use of reports and maps from Lerchen's examination in 1937 and Townsend's in 1940.

LOCATION AND ACCESSIBILITY

The Biorka zinc deposit is approximately 3,000 feet southeast from Biorka Harbor along Lode Creek on the north side of Sedanka Island. (See fig. 2.) Sedanka Island, 166° 14' west longitude, 53° 48' north latitude, is geographically a part of Unalaska Island and lies west of and near one of the most frequented routes from the Pacific Ocean to the Bering Sea. (See fig. 1.)

The deposit is readily accessible to ocean-going ships, as a dock can be prepared in Biorka Harbor at a nominal cost to accommodate the largest ships now used for freighting. Ships of the Alaska Steamship Co. now call at Dutch Harbor on their trips to northwestern Alaska and the Bering Sea. The freight rate of the Alaska Steamship Co. on general cargo during 1945 from Seattle, Wash., to Dutch Harbor on Unalaska Island was \$1.25 a hundred pounds or \$0.62-1/2 a cubic foot, whichever was greater. Passenger rates were as follows: Class 8, \$105 plus 16 percent surcharge plus 15 percent tax; lower first class, \$90 plus 16 percent surcharge plus 15 percent tax; and steerage, \$53, plus 16 percent surcharge plus 15 percent tax.

Prior to World War II, the Alaska Steamship Co. maintained a shuttle service from Seward, Alaska, to Kodiak Island and Dutch Harbor. This service was abandoned during the war and has not yet been resumed (February 1946). At present there is no commercial air transportation to the Aleutian Islands.

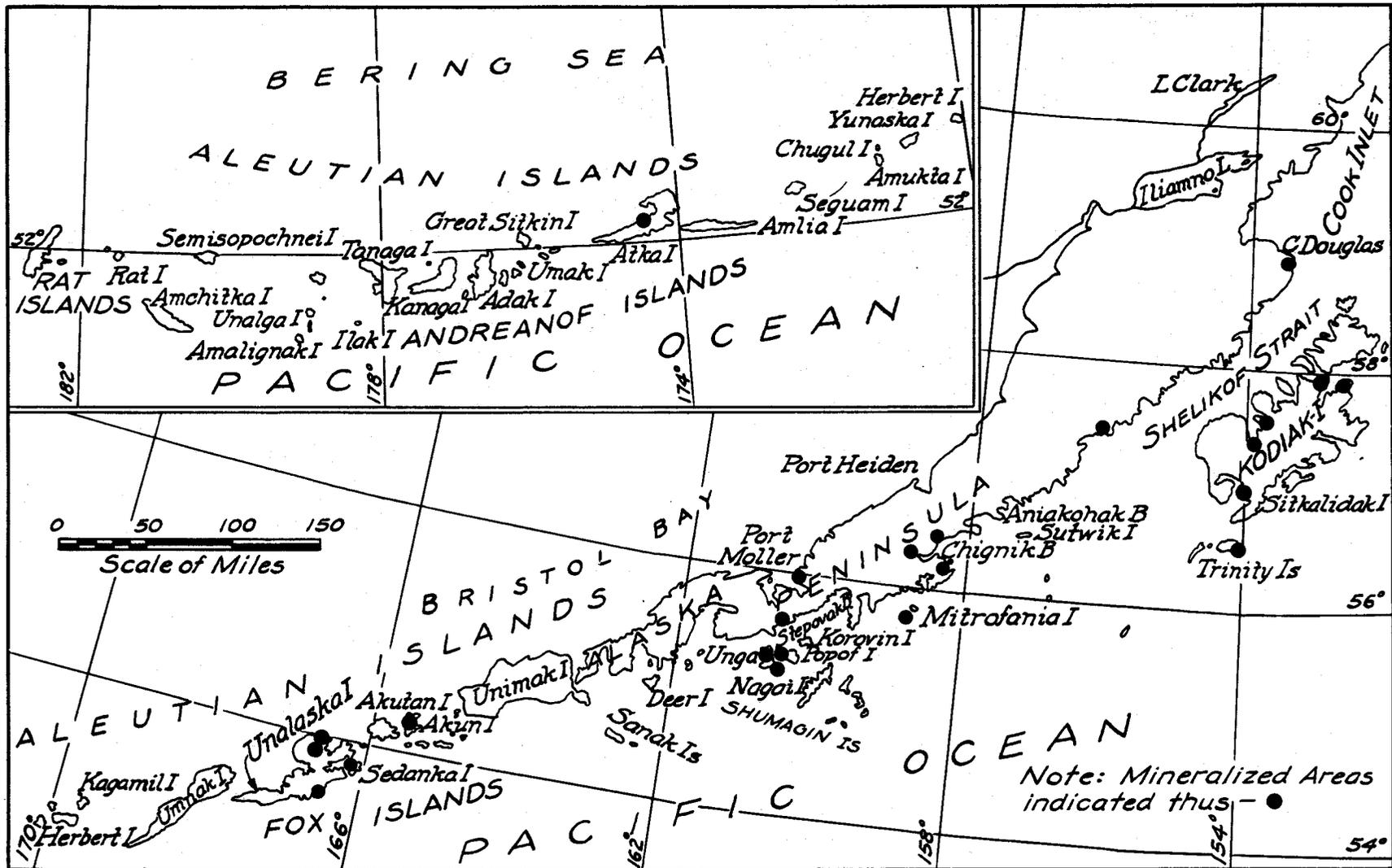
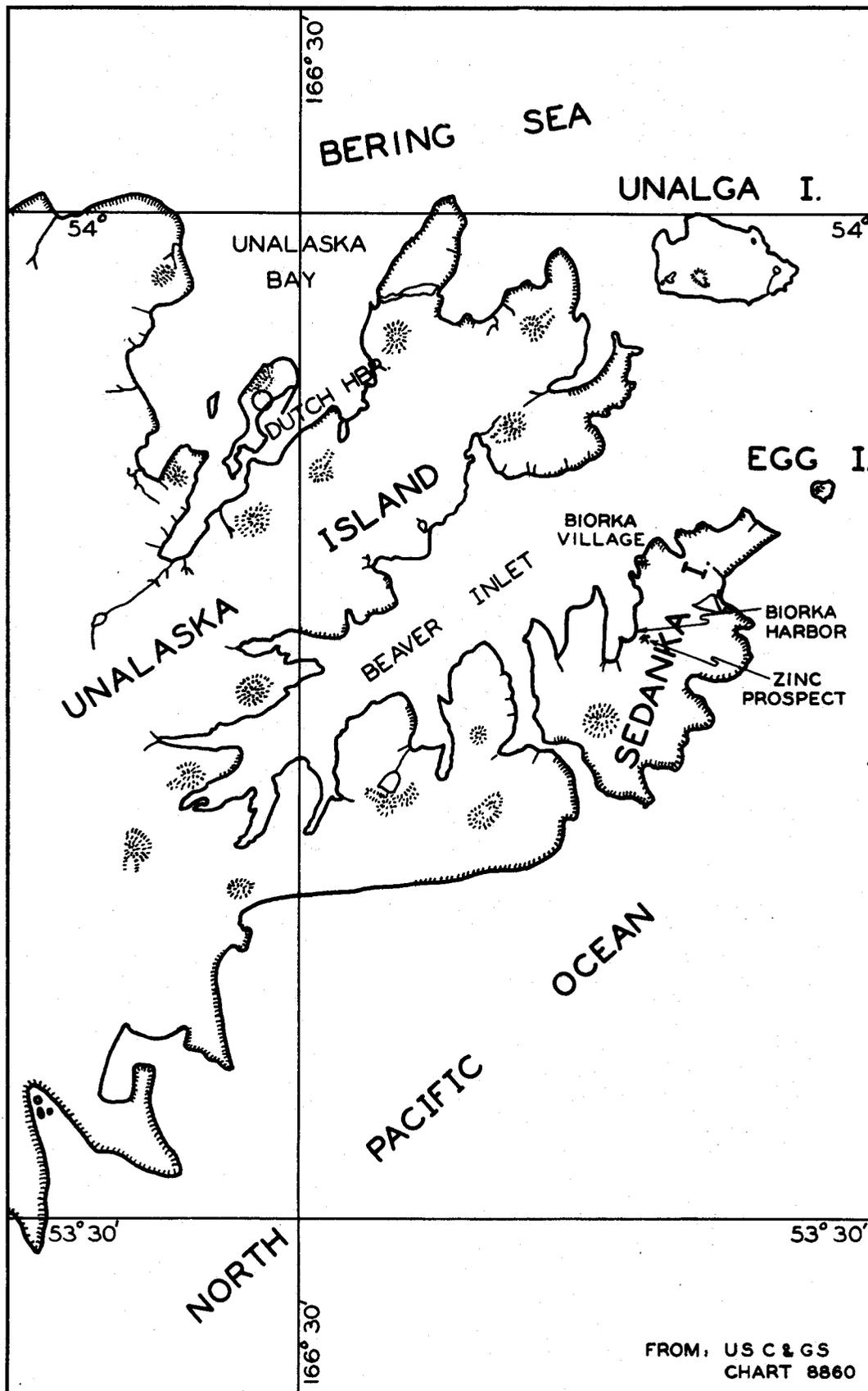


FIG. 1 - INDEX MAP, ALASKA PENINSULA - ALEUTIAN ISLANDS



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FIG. 2

LOCATION MAP ~ SEDANKA ISLAND

Until exploration and development of the Biorka zinc deposit warrants the construction of a dock in Biorka Harbor, all supplies and equipment must be obtained through Dutch Harbor on Unalaska Island. Dutch Harbor is about 25 miles by water from the dock-site, and small fishing boats may be chartered in Dutch Harbor for this service, but with difficulty during the fishing season.

PHYSICAL FEATURES AND CLIMATE

Sedanka Island is one of the many islands forming the Aleutian Islands, virtually a continuation of the Alaska Peninsula, which separate the Pacific Ocean from the Bering Sea. The island is bare of timber and, except for a few stunted willows along the creeks, is covered only by grasses and moss. Two mountains rise to 2,200 and 1,500 feet, respectively.

Lying as it does between the warm waters of the Pacific Ocean and the cold waters of the Bering Sea, the island has an abundance of rain and foggy weather. Winters are usually stormy, but the temperature is mild. Summers are cool.

Records of the United States Weather Bureau for Dutch Harbor for 16 years, 1905 to 1920, inclusive, show a mean annual precipitation of 63.69 inches. The greatest amount recorded was in October, June and July having the least. Most of the precipitation occurred during the fall and winter months.

The mean annual temperature recorded at Dutch Harbor over a 27-year period, 1892 through 1921, was 39.8° F. Only in January and February was the mean monthly temperature below 32° F.

LABOR AND LIVING CONDITIONS

No accommodations or labor are available near the zinc deposit. Before exploring or developing can be done, some form of housing must be provided. The United States will be the best source for the required labor, though a few natives might be obtained from Dutch Harbor for unskilled work. The isolation and disagreeable weather of the island would affect the attitude of mining personnel toward remaining in the region at ordinary rates of pay.

HISTORY, PRODUCTION, AND OWNERSHIP

The Biorka zinc deposit is still undeveloped. The property, composed of eight unpatented lode claims, is held jointly by Fred H. Johnstone, Unalaska, Alaska, and W. C. Brown, 455 South 162d Street, Seattle 88, Wash.

The area was examined by F. H. Lerchen, Mining engineer, in 1937 and by Harry Townsend, Mining engineer, in 1940.

George Gates of the Federal Geological Survey examined the area briefly in August 1944, but his report has not as yet been released.

DESCRIPTION OF DEPOSIT

Zinc mineralization at the Biorka deposit is confined to the hanging-wall section of a fault striking N. 83° E. across Sedanka Island and dipping approximately 55° south (fig. 2). Mineral deposition has been controlled structurally by a series of nearly vertical fractures (80° to 90° to SW.) in the diorite forming the hanging wall of the fault. The fractures have an average strike of S. 60° E. and are more closely spaced and mineralized as they approach the fault plane. (See figs. 3 and 4.) The footwall is an unmineralized fine-grained greenstone.

Zinc sulfide mineralization does not approach uniformity along the exposed strike interval, nor is it consistently strongest close to the fault. A few very rich stringers persist well up into the section. It is generally true, however, that there is a progressive and rather uniform reduction in zinc sulfide content of the mineralized fractures as they recede from the fault plane.

Mineralization consists of sphalerite and pyrite with a small amount of galena and chalcopyrite in a gangue of quartz and the mixed carbonate mineral ankerite. The sphalerite is coarsely crystalline, with a grain size chiefly between 10- and 48-mesh. Pyrite also occurs scattered throughout the gangue rock.

Though there is a rather uniform reduction in zinc sulfide content of the fractures progressively away from the fault, it is not always true. In a mining operation it is probable that this limit will have to be determined at close intervals by assay.

A mineralized zone 240 feet along the fault was stripped and sampled. The mineralized fractures in this shoot have a maximum height, measured normal to the fault plane, of over 60 feet, and average about 45 feet. The shoot has a calculated easterly rake of 38 degrees.

Both the eastern and western limits of the area sampled are flanked by small, lightly mineralized outcrops, which are well above the projected footwall fault. It is reasonable to assume that they represent the upper extremities of fractures that are more highly mineralized as they approach the fault. On this basis, it is logical to extend the strike length of the shoot by a minimum of 50 feet.

The very limited surface exploration, including that accomplished during this examination, has been confined to a section along the fault particularly favored by topography and proximity to Lode Creek. The presence of the fault is indicated at the beach line, about 3,000 feet west of the sampled area and on the approximate projection of the fault, by a series of fractures similar to those observed at the shoot. The fractures outcrop in a very small exposure at the base of the cliff and are mineralized by pyrite only. If this tentative correlation is correct, the favorable vertical section of the fracture zone would lie some 50 feet below this exposure. The strike interval between the beach and Fall Creek, nearly 3,000 feet, is uninterrupted by tundra. The fault has been exposed at Fall Creek, about 250 feet west of the sampled area, and

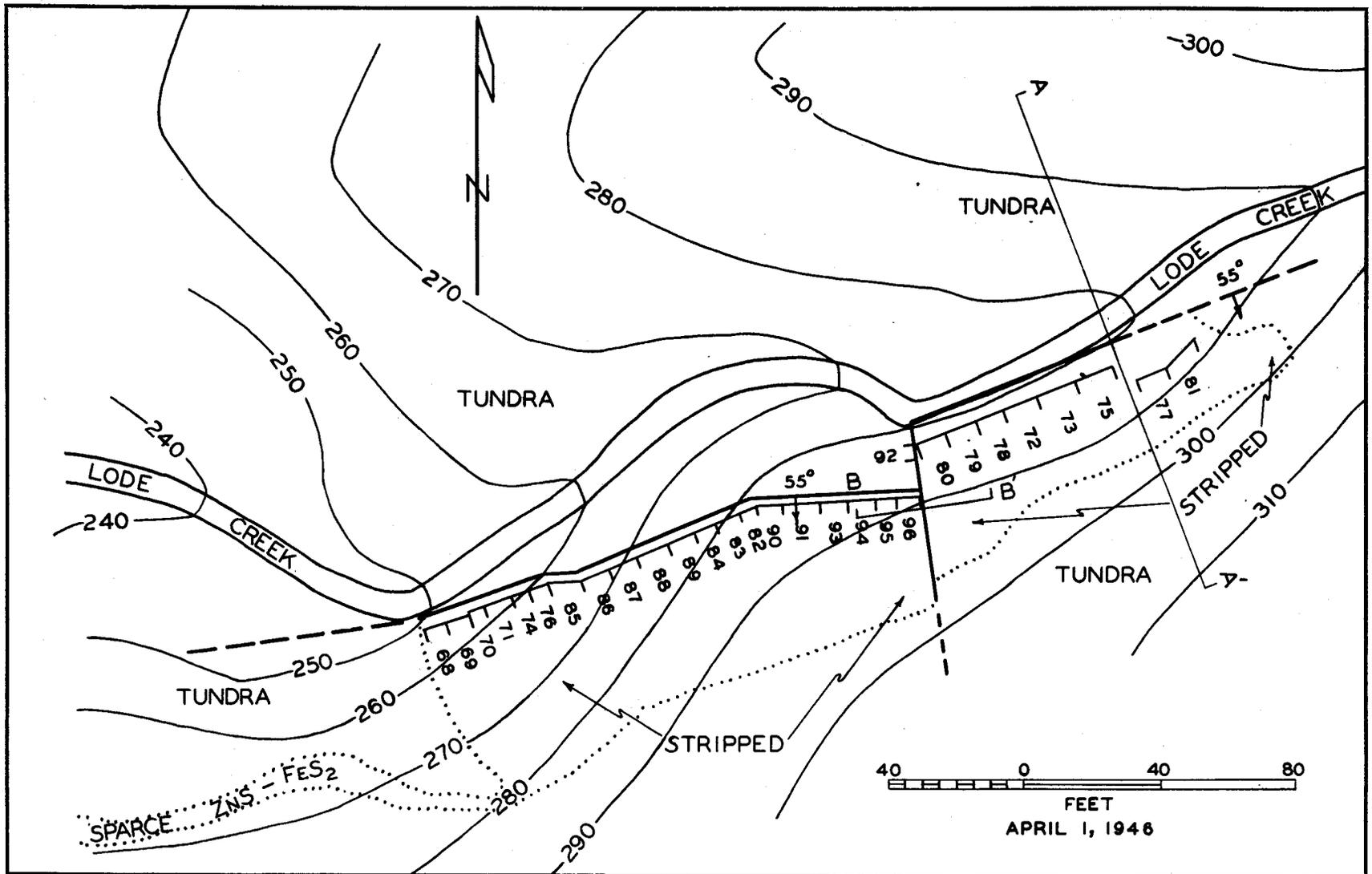


FIG. 3 BIORKA ZINC DEPOSIT, SEDANKA ISLAND, AAA.

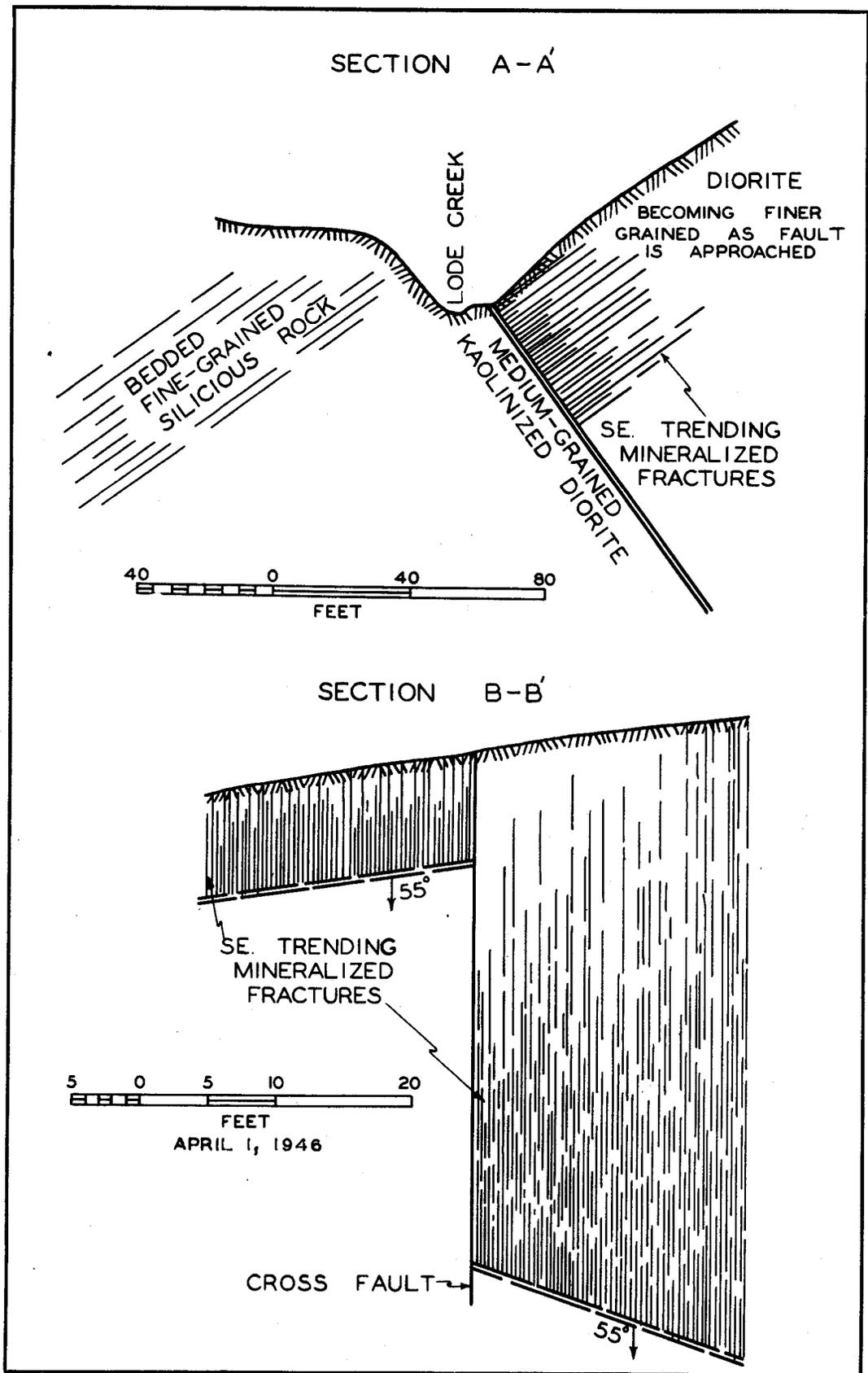


FIG. 4 VERTICAL SECTIONS ~ BIORKA ZINC

at several points within this 250-foot interval, but the mineralization is light and confined to pyrite. Fractures characteristic of the ore shoot... were not observed.

East of the proved area the topography suggests that the fault continues to the east shore of Sedanka Island, some 2 miles distant. For about 1 mile immediately east of the mineralized area, the bedrock is apparently heavily overburdened, and only occasionally outcrops occur further along the projected trend of the fault. The fault was not observed in this direction, and mineralization either in place or as float was not found.

EXPLORATION BY THE BUREAU OF MINES

The Biorka zinc deposit was examined by the Bureau from June 19 through July 10, 1945. The program consisted of stripping the overburden along the fault for an average width of 40 feet over a strike length of 250 feet and sampling. Trenches excavated during previous examinations had caved, and the entire area was covered.

A unique method of trenching and stripping the overburden was made possible by the steep topography adjacent to Lode Creek. Two gasoline-driven fire pumps with 3-inch discharge and several hundred feet of fire hose were borrowed from the Army. Nitrostarch was purchased from the Army and used in blasting and removing the covering of moss, other vegetation, and soil also. In stripping the overburden, the dense mat of vegetation and top soil was first removed by blasting and by hand. Then the pumps were set up beside the creek at a point where the hose could be laid on grade to the area to be stripped. This was possible because of the steep gradient of the creek, and the static head was reduced to virtually zero. Thus, the small pump delivered a large volume of water and increased the capacity of the sluicing operation. All overburden was removed, and the bedrock was washed clean before sampling.

The use of explosives in conjunction with the two pumps made it possible to move a very considerable amount of overburden in a short time with a minimum of hand work.

The extension of the area stripped by this method proved the existence of zinc ore in an area not previously prospected. Twenty-nine channel samples were cut over an aggregate length of 248.2 feet.

The samples were crushed and split, and representative portions were submitted to the Territorial Assay Office, Ketchikan, Alaska, for analysis. The sample rejects were combined to form a 350-pound sample, which was shipped to the Metallurgical Branch, Bureau of Mines, Salt Lake City, Utah, for beneficiation.

SAMPLING AND ANALYSES

The structural control of the mineralization was determined to be the closely spaced fractures in the diorite hanging wall of the fault. Length of the fractures as well as the strength of mineralization varied. Deposition of sphalerite, chalcopyrite, and galena has been heaviest close

to the fault plans and gradually fades out in a direction normal to the fault plane. As there was not enough time to carry sample channels both parallel and normal to the fault, a line of sampling was carried approximately parallel to and within a few feet of the fault plane. (See fig. 3.) By inspection, it was estimated that the average grade 15 feet from the fault will be 20 percent lower than that of the section just above the fault plane.

Analyses of samples are given in the following tables. Location of samples is shown on figure 3. The average analysis of the 29 samples taken over a length of 240.4 feet is 6.8 percent zinc. However, if the first 7 samples on the west are eliminated, the average of the other 22 samples is 8.0 percent zinc over a length of 189.8 feet.

Eliminating the 7 samples on the west and the last 3 on the east, the 19 remaining consecutive samples over a length of 158.8 feet average 9.1 percent zinc, 0.24 percent lead, 0.45 percent copper, 0.04 ounce gold, and 1.4 ounce silver a ton.

The zinc analyses and widths of samples are shown in table 1:

TABLE 1. - Analyses of Bureau of Mines' samples
(by Nils Johansson)

Samples	Sample width, feet	True width, feet	Percent Zinc
68	7.2	7.0	2.4
69	7.9	7.7	6.9
70	4.8	4.7	Tr.
71	9.1	8.9	1.26
74	5.6	5.5	Tr.
76	5.7	5.6	.3
85	12.3	11.2	2.4
	52.6	50.6	2.2
86	8.9	8.7	13.9
87	9.6	9.4	11.2
88	9.4	9.2	2.9
89	8.4	8.2	11.6
84	7.2	7.0	14.3
83	6.9	6.7	14.7
82	6.2	6.0	6.7
90	9.0	9.0	7.9
91	11.2	11.2	1.0
93	7.5	7.5	4.9
94	8.3	8.3	4.1
95	6.2	6.2	3.8
96	6.5	6.5	14.7
92	4.5	3.5	10.0
	109.8	107.4	8.3

TABLE 1. - Analyses of Bureau of Mines' samples
(by Nils Johansson) (Cont'd.)

Samples	Sample width, feet	True width, feet	Percent zinc
80	10.6	10.3	15.1
79	10.0	9.7	15.6
78	8.0	7.8	11.45
72	11.4	11.1	7.2
73	12.8	12.5	6.2
75	11.2	10.9	3.5
77	8.7	8.5	.7
81	13.1	11.6	3.0
	85.8	82.4	7.7
Average ..	248.2	240.4	6.8

The results of composite sample analyses for lead and copper are shown in table 2:

TABLE 2. - Analyses of Bureau of Mines samples
(by Nils Johansson)

Samples	True width, feet	Percent		
		Zinc	Lead	Copper
68 and 69	14.7	4.8	Tr.	0.04
70 and 71	13.6	.8	Tr.	Tr.
74 and 76	11.1	.2	.2	Tr.
85	11.2	2.4	Tr.	Tr.
	50.6	2.2	.04	.01
86 and 87	18.1	12.5	0.10	0.14
88	9.2	2.9	Tr.	Tr.
89 and 84	15.2	12.8	.40	.28
83 and 82	12.7	10.9	Tr.	.14
90	9.0	7.9	Tr.	Tr.
91	11.2	1.0	Tr.	Tr.
93	7.5	4.9	Tr.	.18
94, 95 and 96	21.0	7.3	.10	.05
92	3.5	10.0	Tr.	.9
	107.4	8.3	.09	.13
80	10.3	15.1	0.3	2.36
79 and 78	17.5	13.8	1.5	1.60
72 and 73	23.6	6.7	Tr.	.23
75	10.9	3.5	.3	.57
77 and 81	20.1	2.0	Tr.	.09
	82.4	7.7	.40	.80
Average	240.4	6.8	0.19	0.33

NOTE. - Percent zinc was calculated for the composite samples.

Analyses for gold, silver, and cadmium of three composite samples are shown in table 3. Zinc, lead, and copper analyses were calculated.

TABLE 3. - Composite analyses (by Nils Johansson)

Samples	Ounce per ton			Percent		
	Gold	Silver	Zinc	Lead	Copper	Cadmium
86, 87, 89, 84, 82, 79 and 78 ..	0.06	1.80	12.5	0.60	0.61	Nil
68, 69, 88, 83, 90, 93, 92, 80, 72, 73, and 75 .....	.02	1.00	7.2	.07	.43	Nil
70, 71, 74, 76, 85, 91, 94, 95, 96, 77, and 81	Tr.	Tr.	2.8	.05	.03	Tr.
Average .....	.02	.82	6.8	.19	.33	Tr.

COMPARISON OF SAMPLING AND ANALYSES

The single shoot of mineralization on Sedanka Island explored by the Bureau during a preliminary examination in July 1945 was partly exposed and sampled by F. H. Lerchen in June and July, 1937. The deposit was also examined in 1940 by Harry Townsend. Comparison of the results of the three programs of sampling and analyses follows.

The assay map from Lerchen's report on the deposit shows samples taken from three areas. Two of these, B and C, correspond roughly to the east and west limits of the 240-foot zone sampled by the Bureau. Lerchen's map shows 117 feet of "moss-covered greenstone" separating areas B and C, whereas stripping and sampling by the Bureau proved a continuous mineralized zone. The ten samples taken by Lerchen from zone C have a weighted average of 9.85 percent zinc, 0.2 percent lead, 0.37 percent copper, 0.018 ounce a ton gold, and 0.56 ounce a ton silver. Samples from zone B averaged 8.50 percent zinc, 0.84 percent lead, 1.05 percent copper, 0.041 ounce a ton gold, and 0.77 ounce a ton silver. It is possible that Lerchen did not uncover the main fault where it is offset by a cross fault and thus failed to expose the mineralized zone intervening between areas B and C.

Lerchen cut three samples from area A, which is 200 feet east of area B. The analysis of sample A-3 is 9.7 percent zinc, 4.1 percent lead, 0.11 percent copper, 0.27 ounce a ton gold and 0.5 ounce a ton silver for a width of 0.5 feet. Samples A-1 and A-2 were low-grade material.

The short time available did not permit the Bureau's engineer to examine this area.

Harry Townsend's samples were taken from approximately the same two areas as Lerchen's areas B and C. The Townsend assay map indicates a gap in sampling both areas; these were assumed to be barren. The west area, corresponding to area C, averaged 6.1 percent zinc, 0.01 ounce a ton gold, and 0.27 ounce a ton silver, representing an area 45 feet long by 10 feet wide. The east ore shoot, corresponding to area B, averaged 6.7 percent zinc, 0.13 ounce a ton gold, and 0.60 ounce a ton silver representing an area 50 feet long by 10 feet wide. However, if the missing samples were assumed to be of average grade for each zone, the west area would average

6.6 percent zinc, 0.01 ounce a ton gold, and 0.30 ounce a ton silver, and the east area would average 8.04 percent zinc, 0.16 ounce a ton gold, and 0.72 ounce a ton silver.

TABLE 4. - Analyses of samples cut by F. H. Lorchen

C area or west ore shoot, 45 by 15 feet

Sample	Width, feet	Percent			Oz/ton	
		Zn	Pb	Cu	Au	Ag
C-1	17.75	5.60	0.10	0.33	0.02	0.50
C-10	11.20	10.60	.20	.43	.02	.7
C-5	10.50	15.50	.20	.86	.02	.95
C-8	10.40	19.00	.30	.51	.02	.9
C-7	7.00	1.20	.20	Tr.	.015	.1
C-6	7.00	.70	.10	Tr.	.015	.1
C-4	14.50	5.50	.30	.23	.015	.5
C-3	9.00	12.70	.10	.31	.025	.4
C-2	12.60	8.70	.10	.33	.02	.3
C-11	13.00	16.70	.30	.55	.01	.8
Average	112.95	9.85	.20	.37	.018	.56

NOTE. - Area B separated from area C by 117 feet, which was not sampled.

B area or east ore shoot, 85 by 20 feet

B-5	12.00	13.70	0.30	0.55	0.030	0.80
B-4	13.90	16.50	1.90	.86	.090	.90
B-3	17.00	3.60	.50	1.10	.030	.70
B-2	15.60	4.70	.65	1.57	.025	.80
B-1	8.60	5.10	.90	1.02	.025	.65
Average	67.10	8.50	.63	1.05	.041	.77
Combined average	180.05	9.35	0.36	0.63	0.026	0.64

NOTE. - Area B separated from area A by 200 feet, which was not sampled.

"A" area

A-1	3.2	0.60	0.20	0.27	Tr.	0.20
A-2	7.5	.50	.10	.02	0.01	.10
A-3	.5	9.70	4.10	.11	.27	.50

TABLE 5. - Analyses of samples cut by Harry Townsend

West ore shoot, 45 by 10 feet

Sample	Length of sample, feet	Zn, percent	Au, oz/ton	Ag, oz/ton
JB-9	6.0	12.2	0.02	1.02
JB-8	9.0	3.4	Tr.	Nil
No sample	3.0	-	-	-
JB-7	6.5	2.6	.02	Nil
JB-6	8.0	1.0	Tr.	.20
JB-5	6.0	17.7	.02	.46
Average	38.5	6.1	.01	.27

East ore shoot, 50 by 10 feet

JB-4	9.0	11.3	0.02	0.60
No sample	6.0	-	-	-
JB-3	7.0	7.9	.60	.94
JB-1	6.5	6.7	.04	.52
JB-2	8.0	5.6	.04	.84
Average	36.6	6.7	.13	.60
Combined average	75.1	6.4	.07	.43

NOTE. - West ore shoot separated from East ore shoot by 120 feet that was covered by slide rock.

BENEFICIATION

Sample rejects from the Bjorka zinc deposit were combined, and the composite sample was shipped to the Metallurgical Branch, Bureau of Mines, at the Salt Lake City Experiment Station for beneficiation. The chemical composition of a representative sample of the ore is indicated by the following analysis:

Chemical analysis, percent

Total		Oxide											
Cu	Pb	Zn	Cu	Pb	Zn	Fe	CaO	Cd	Insol	SiO ₂	S	Al ₂ O ₃	MgO
0.31	0.3	8.8	.02	.05	0.4	12.7	3.0	0.05	46.0	43.5	8.25	7.64	2.15
Oz/ton													
Au.		Ag.											
/0.005		0.55											

The sulfide minerals in the ore are sphalerite and pyrite with a small amount of galena and chalcopyrite. The sphalerite is coarsely crystalline, its grain size lying chiefly between 10- and 48-mesh. Chalcopyrite and galena are present in grains 35 mesh and smaller.

The gangue consists of quartz, and the mixed carbonate mineral is ankerite. Quartz occurs as small seams 10- to 65-mesh in width scattered

throughout the ankerite, and the sphalerite, chalcopyrite, and galena appear to be associated with it. Pyrite occurs both in the quartz and scattered throughout the gangue rock.

Examination of a zinc concentrate indicates that the sphalerite is probably marmatitic in part. Its color varies from colorless to light yellow and red brown.

Microscopic examination of the ore indicated that the sphalerite is fairly coarsely crystallized and free of gangue chalcopyrite and pyrite at about 65-mesh. The ore is readily concentrated by flotation. Over 94 percent of the zinc can be concentrated in a product assaying 59.2 percent zinc, 0.1 percent lead, 0.6 percent copper, 4.05 percent iron, 0.32 percent cadmium, and 1.2 percent insoluble. It is questionable whether the small lead and copper content of the ore should be floated as a separate product. However, if such a concentrate is floated, it will assay 11.4 percent lead, 12.2 percent copper, and 12.4 percent zinc, and will contain 75 percent of the lead, 53 percent of the copper, and 2 percent of the zinc in the ore.

Coarse Gravity Treatment

A representative sample of the Biorka ore, as received, was sized on a 20-mesh screen; the screen oversize was treated by jiggling and the under-size by table concentration. Results of this test indicate that recoveries of 82 percent of the lead, 84 percent of the copper, and 89 percent of the zinc can be obtained in a combined concentrate representing half of the original weight and assaying 15.56 percent zinc, 0.51 percent copper, 0.28 percent lead, 12.5 percent iron, and 36.5 percent insoluble. Nearly 40 percent of the original weight was rejected as a plus 20-mesh jig tailing. As the ore was relatively finely crushed as received, the results of this test should warrant investigation of sink-and-float methods of treatment at coarser sizes.

Selective Flotation

The Biorka zinc ore is readily amenable to flotation, and recoveries of 94 to 96 percent of the zinc were obtained in plus-50 percent zinc concentrates. As the lead and copper content of the ore is very low, production of a separate lead-copper concentrate might be of questionable value. The combined lead-copper-zinc concentrate assays 1.2 percent lead, 1.7 percent copper, 54.7 percent zinc, 5.69 percent iron, 1.87 percent insoluble, and 0.30 percent cadmium. The product represents a recovery of 81 percent of the lead, 78 percent of the copper, and 96 percent of the zinc. However, if a lead-copper concentrate is removed first, 94 percent of the zinc can readily be recovered in a premium product assaying 0.1 percent lead, 0.6 percent copper, 59.2 percent zinc, 4.05 percent iron, 1.2 percent insoluble, and 0.32 percent cadmium. The lead-copper product assayed 11.4 percent lead, 12.2 percent copper, 12.4 percent zinc, and contained 75 percent of the lead, 53 percent of the copper, and 2 percent of the zinc. Although the precious-metal content of the ore is low, it can be concentrated in the lead-copper product, and this concentrate would assay 0.05 to 0.08 ounce gold and 20 to 36.2 ounce silver per ton.

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TABLE 6. - Gravity concentration

Product	Assay No.	Weight, grams	Percent weight	Assay, percent					Distribution, percent		
				Pb	Cu	Zn	Fe	Insol.	Pb	Cu	Zn
Jig concentrate	56025	742	16.5	0.4	0.62	21.2	11.4	32.4	38.0	33.0	39.3
1 jig middlings	56024	454	10.1	.2	.32	8.6	12.25	46.6	11.6	10.4	9.8
2 jig middlings	56023	377	8.4	.25	.40	9.8	12.1	44.4	12.1	10.8	9.2
Jig tailings*	56022	1778	39.6	.07	.10	2.0	13.3	54.6	16.0	12.8	8.9
Table concentrate	56021	525	11.7	.2	.65	19.0	14.6	27.4	13.5	24.5	25.0
Table middlings*	56020	124	2.8	.05	.12	2.3	11.95	54.6	0.8	1.1	0.7
Table sands*	56019	303	6.7	.02	.08	1.8	11.2	58.8	0.7	1.7	1.4
Table slimes	56018	187	4.2	.3	.42	12.1	12.1	38.6	7.3	5.7	5.7
Calculated head		4490	100.0	.17	.31	8.9	12.7	45.7	100.0	100.0	100.0
Combined concentrates			50.9	.28	.51	15.56	12.5	36.5	82.5	84.4	89.0
Combined tailings*			49.1	.06	.10	2.0	12.9	55.2	17.5	15.6	11.0

NOTE. - Sample as received was minus 1/4-inch, and for gravity concentration the plus 20-mesh was jigged and minus 20-mesh material was tabled.

Summary

Preliminary beneficiation studies on ore from the Biorka zinc deposit, Sedanka Island, Alaska, indicate that the ore is readily amenable to concentration by selective flotation. Zinc concentrates assaying 54 to 59 percent zinc can be obtained with 96 percent metal recovery. These concentrates contain 0.3 percent cadmium. Low-grade copper-lead products can be removed if the over-all sampling of the deposit indicates any appreciable quantity of these metals or associated precious metals.

Jig and table concentration of the minus 1/4-inch ore as received indicated that the grade could be doubled with a loss of 10 to 15 percent of the zinc. Further gravity tests employing sink-and-float methods should be investigated on coarser sizes of ore.

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TABLE 7. - Selective flotation

Reagents, pounds per ton

Grind, 12 min.	Pb-Cu float	Zn float
CaO - 2.0	B-23 - 0.04	CaO - 4.0
ZnSO ₄ - 4.0		CuSO ₄ - 2.0
NaCN - .5		Z-6 - .32
Min. 194 - .08		B-23 - .04

Metallurgical data

Product	Assay No.	Wt., grams	Percent wt.	Assay, percent						Distr. percent		
				Pb	Cu	Zn	Fe	Insol.	Cd	Pb	Cu	Zn
Pb-Cu concentrate ..	55842	9.0	1.5	11.4	12.25	12.4	21.2	8.2	0.06	74.8	52.8	2.1
Zn concentrate	55843	86.0	14.3	.1	.61	59.2	4.05	1.2	.39	6.3	25.1	94.0
Zn cleaner tailing .	55844	14.8	2.4	.1	.99	4.4	16.8	41.6	-	1.0	6.8	1.2
Ro. tailing	55845	493.4	81.8	.05	.065	.3	14.05	54.1	-	17.9	15.3	2.7
Calculated head		603.2	100.0	.23	.35	9.0	12.8	45.5	-	100.0	100.0	100.0
Bulk concentrate ...		95.0	15.8	1.2	1.7	54.7	5.69	1.87	0.30	81.1	77.9	96.1

NOTE: Approximate precious metal content of Pb-Cu concentrate = 0.05 ounce Au and 20 ounces Ag.

TABLE 8. - Selective flotationReagents, pounds per ton

Grind, 15 min.	Pb-Cu float	Zn float
CaO - 2.0	B-23 - 0.04	CaO - 3.0
ZnSO ₄ - 4.0		CuSO ₄ - 2.0
NaCN - .5		Z-6 - .24
Min. 194 - .08		B-23 - .08

Metallurgical data

Product	Assay no.	Weight, grams	Percent, weight	Assay, percent					Oz/ton		Distribution, percent				
				Pb	Cu	Zn	Fe	Insol.	Au	Ag	Pb	Cu	Zn	Au	Ag
Pb-Cu concentrate ..	56026	15.5	0.64	26.7	5.10	13.2	18.9	2.4	0.08	36.2	67.0	9.8	0.9	10.2	42.2
Cl. tailing	56027	11.7	.48	5.75	1.41	6.7	20.0	26.8	-	-	10.8	2.1	.4	-	-
Zn concentrate	56028	360.6	14.87	.10	1.55	56.8	4.8	.8	-	-	5.8	69.8	95.3	-	-
Zn cleaner tailing .	56029	76.2	3.14	.05	1.28	3.1	16.0	44.0	-	-	.6	12.2	1.1	-	-
Ro. tailing	56030	1,961.0	80.87	.05	.025	.25	14.2	54.6	-	-	15.8	6.1	2.3	-	-
Calculated head		2,425.0	100.00	.26	.33	8.86	12.9	45.8	.005	.55	100.0	100.0	100.0	-	-
Bulk concentrate ...		387.8	15.99	1.36	1.69	53.5	5.81	1.65	-	-	83.6	81.7	96.6	-	-

Remarks:	<u>Grind</u>	<u>Percent</u>
	+100-mesh	1.3
	+200-mesh	16.0
	-200-mesh	82.7