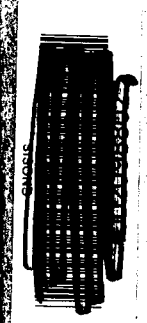


UNITED STATES DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary

BUREAU OF MINES
R. R. Sayers, Director

War Minerals Report 191

RED MOUNTAIN CHROMITE DEPOSITS KENAI PENINSULA, ALASKA

RESTRICTED This document contains information affecting the national defense of the United States within the meaning of the Espionage Act, 50 U.S.C., 31 and 32, as amended. Its transmission to or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

WASHINGTON: 1944

RESTRICTED

WAR MINERALS REPORT

UNITED STATES DEPARTMENT OF THE INTERIOR — BUREAU OF MINES

W.M.R. 191 - Chromium May 1944

RED MOUNTAIN CHROMITE DEPOSITS

Kenai Peninsula, Alaska

SUMMARY

The chromite deposits of Red Mountain, 12 miles southeast of Seldovia, Alaska, are in an intrusion of ultramafic rocks. Exploration by the Bureau of Mines has indicated 128,560 tons of chromite ore with an average content of 19.6 percent Cr_2O_3 in the Chrome Queen, No. 2, and other deposits. In the event a mill is built, this ore can be mined and milled to produce 56,516 long tons of direct shipping ore containing 41.6 percent Cr_2O_3 and 18,100 long tons of concentrates with an average grade of 45 percent Cr_2O_3, or a total of 74,616 tons of marketable ore. If no mill is built, and using a 38 percent cut-off, it is estimated that 49,486 tons can be mined, which will yield 39,786 long tons of hand-sorted ore containing 43.27 percent Cr_2O_3 from these deposits.

Beneficiation tests by the Bureau of Mines on similar ores have demonstrated that these ores can be concentrated by gravity methods.

An access road has been completed by the Alaska Road Commission, and 5,000 tons of 43.0-percent Cr_2O_3 ore from the Chrome Queen ore body has been mined and delivered to the Metals Reserve Co. stock pile.

If the war program should be seriously dependent on high-grade metallurgical chromite from this area, the program herein outlined is recommended to bring these reserves into production.

INTRODUCTION

A preliminary investigation of the Kenai chromite deposits was made in July and August 1941 by R. S. Sanford, district engineer of the Bureau of Mines, and P. W. Guild, assistant geologist of the Geological Survey. This was followed by surface sampling and core drilling, which were completed in September 1942 under the direction of John W. Cole, associate engineer of the Bureau of Mines The Geological Survey had a field party in the region from July until September 1940. The Red Mountain area was mapped, and geological data were assembled. G. O. Gates, assistant geologist, and A. B. Unkelsbay, junior geologist, of the Geological Survey, logged cores and interpreted geologic features revealed by Bureau of Mines' drilling and trenching.

J. C. Roehm, associate engineer of the Territorial Department of Mines, examined the Red Mountain area in August 1941.

Progress of mining and development in this area by the Chrome Queen Mining Co. and the Red Mountain Chromite, Inc., was examined by F. A. Rutledge, associate engineer of the Bureau of Mines, during October 1943.

GENERAL INFORMATION

Location and Accessibility

The location of Kenai Peninsula is shown on figure 1.

Red Mountain, a bald, dun-colored mass rising to an altitude of 3,400 feet, is near the tip of Kenai Peninsula, about 10 miles southeast of Seldovia. Because of its visibility from the Gulf of Alaska and Kachemak Bay, it is an old mariners' landmark. The principal chromite areas of Kenai Peninsula are shown on figure 2.

Red Mountain is 9 miles by road from Kasitsna Bay, which is 10 miles by boat from Seldovia. The area is part of the Third

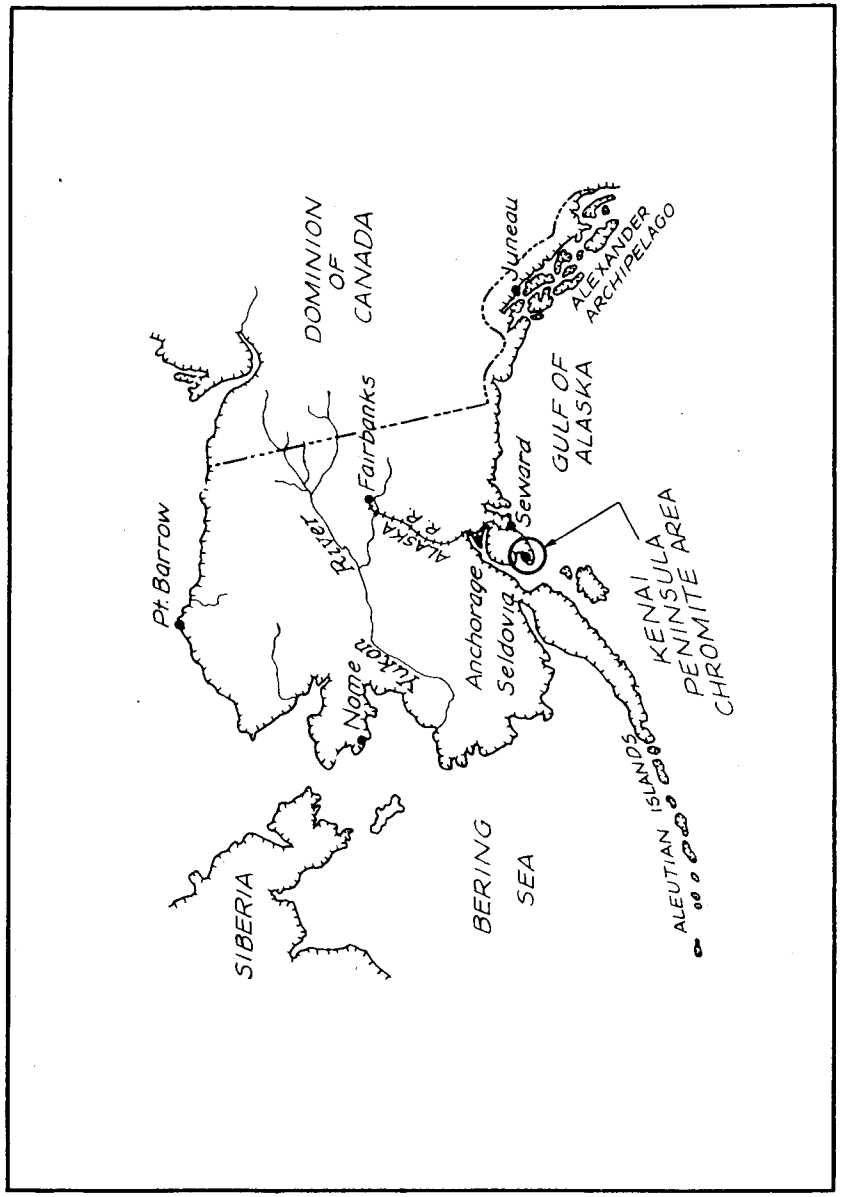


FIG. 1- INDEX MAP, KENAI PENINSULA ALASKA

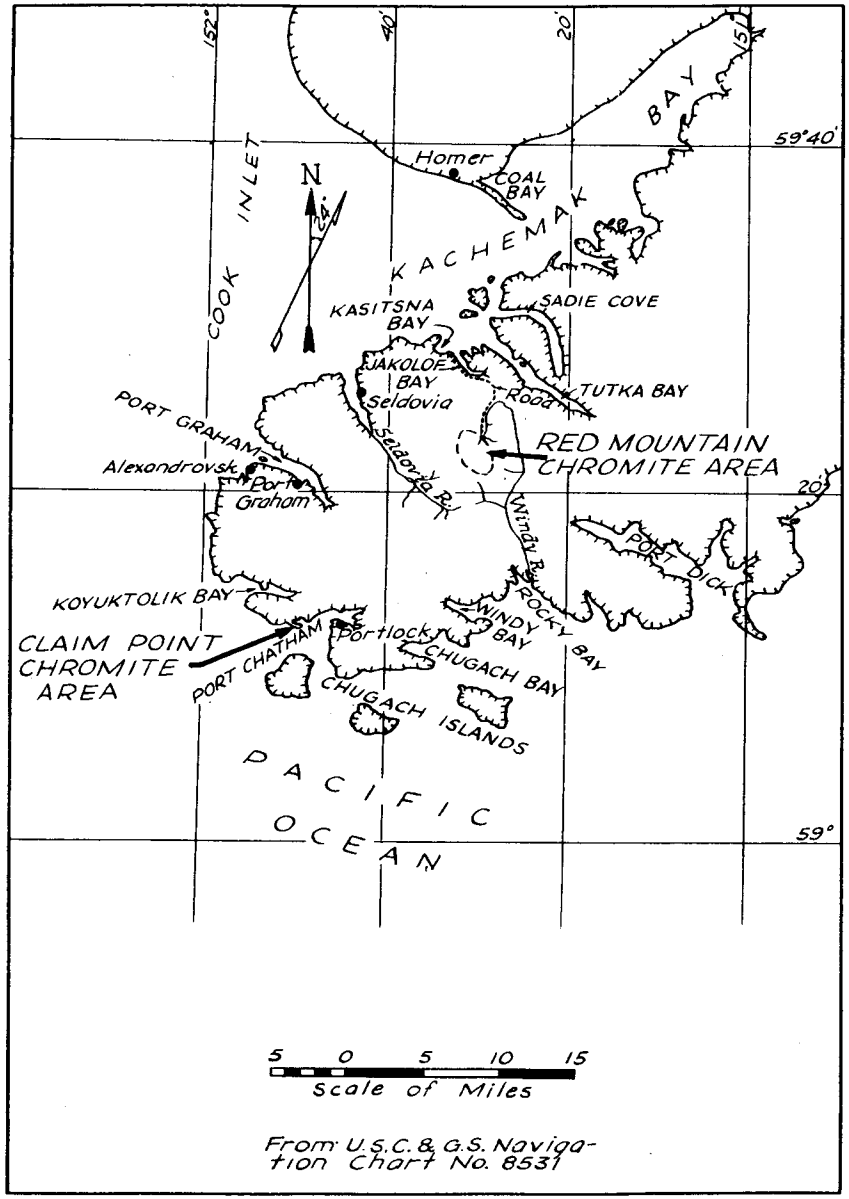


FIG. 2, KENAI PENINSULA CHROMITE AREAS

Judicial Division of Alaska, with headquarters at Valdez. Homer, northeast of Seldovia, is a small farming community on the north shore of Kachemak Bay, 12 miles by water from Kasitsna Bay.

The Alaska Steamship Co. has maintained monthly service to Seldovia since the entrance of the United States into the war. The company's basic freight rate on machinery from Seattle to Seldovia during the summer of 1942 was 41¼ cents per cubic foot or 82½ cents per hundred pounds, whichever was greater, plus 25 percent emergency surcharge. Rates on groceries and other supplies varied but were generally higher than this. The freight charge from Seldovia to Seattle via the Alaska Steamship Co. on bulk ore valued at less than $60 a ton is $7 a short ton plus 25 percent emergency surcharge, totaling $8.75 a short ton or $9.80 a long ton. The wharfage charge at Seattle is $0.07 a hundred pounds, or $1.57 a long ton. Freight and unloading charges total $11.37 a long ton.

Minimum first-class passage by steamship from Seattle to Seldovia during the summer of 1942 was $111.65 plus 10 percent Federal tax. The one-way trip required about 2 weeks. Transportation may be had at slightly higher cost on the more frequent ships from Seattle to Seward, thence by train to Anchorage, and from there to Homer or Seldovia by plane. Passengers and air express are carried by Pan American Airways from Seattle to Fairbanks and by local plane companies from Fairbanks to other parts of Alaska. Plane fare is $175 plus tax from Seattle to Fairbanks and $65 plus tax from Fairbanks to Homer. Star Airlines maintain triweekly service between Anchorage and Homer.

There is a privately owned radio station at Seldovia that furnishes commercial telegraph service through the Alaska Communications System. Small ocean-going motorships maintain irregular freight service on Cook Inlet, but most local traffic is by small gasoline-powered fishing boats. Groceries and other sup-

plies are available at Seldovia and Homer. The Standard Oil Co. maintains a bulk-oil plant at Seldovia to serve the Cook Inlet area. Fuel and lubricating oils in reasonable quantities may be obtained at prices that compare favorably with United States prices. Low-grade coal may be obtained from Homer at $10 to $12 a ton.

There are a modern high school and hospital at Seldovia.

Physical Features

Vegetation and climate of the Kenai Peninsula are typical of the Alaska coastal region. Although the Red Mountain dunite area is virtually bare of vegetation, there are abundant stands of spruce and poplar trees along the road in Jakolof Creek Valley. The nearest weather station is 20 miles north of Red Mountain, at Homer, where the annual precipitation is 30 to 40 inches. Precipitation is greater on Red Mountain because of the higher elevation and exposed location. Snowfall is heavy, ranging from 5 feet in Windy River Valley to more than 40 feet at altitudes of 2,500 feet or more. Except at lower altitudes, the snow remains on the ground until well into summer. Sea-level temperatures range from zero to 80° but rarely remain below freezing for more than a few days at a time. Above 600 feet, freezing weather and heavy snowfall are the rule from October to May.

Relief at Red Mountain ranges from 1,000 feet in Windy River Valley to more than 3,400 feet at the peak. The area is drained by the Seldovia River, which flows into Seldovia Bay; Fish Creek, which flows into Cook Inlet near Barbara Point; and Windy River, which flows north 2½ miles and then east and south into Rocky Bay on the Gulf of Alaska.

Labor and Living Conditions

Owing to the war, labor is scarce and wage rates are rising. In 1942, the following rates per hour prevailed for a 40-hour week: Skilled, $1.50 to $2; semiskilled, $1.25 to $1.50; common, $0.965. Time and a half is paid for time over 40 hours a week.

The Red Mountain Chromite, Inc., furnishes board and lodging for employees without charge.

Local labor is scarce during the fishing season, which is from June until September; consequently, labor must be imported during that period.

HISTORY

The earliest reference to the deposits is by U. S. Grant.[1] A. C. Gill[2] examined them in 1918, and P. W. Guild[3] investigated them during the summer of 1940.

Many claims were staked in 1917 and 1918, but all of these, with the exception of the Star No. 4 and the Juneau Nos. 1 and 2, which were patented by Lass and Whitney, were allowed to lapse subsequently. The unpatented claims evidently have been held by restaking, as only a small amount of assessment work is evident. Activity was resumed in 1937, and a trail was built by Guy P. Kearns and associates from the head of Jakolof Bay to the area.

The holdings of Kearns & Cooper were leased by the Chrome Queen Mining Co. A Reconstruction Finance Corporation loan was obtained, and development was started in the spring of 1942. At present, about 5,000 tons of high-grade shipping ore has been mined and sold to the Metals Reserve Co. This ore will average 43 percent Cr_2O_3.

The holdings of Lass and Whitney were acquired by John W. Blodgett, Jr., who started building a road from the head of Jakolof Bay in July 1941. The name of the operator was changed later to Red Mountain Chromite, Inc. The road was completed as a pioneer trail in December 1941. Construction on this part of the road was

1 Grant, U. S., and Higgins, D. F., Preliminary Report on the Mineral Resources of the Southern Part of Kenai Peninsula. In Mineral Resources of Alaska, Report on Progress of Investigations in 1909, by A. H. Brooks and others. Geol. Survey Bull. 442, 1910, pp. 168-169.

2 Gill, A. C., Chromite of Kenai Peninsula, Alaska. Geol. Survey Bull. 742, 1922, 52 pp.

3 Guild, P. W., Chromite Deposits of Kenai Peninsula, Alaska. In Strategic Minerals Investigations, 1941. Geol. Survey Bull. 931 (g), 1942, pp. 139-175.

suspended during the winter, but work continued on the 2½-mile section along the south shore of Jakolof Bay to the dock site at Kasitsna Bay. Only enough work to maintain the road for tractor and sled travel was done until September 1942, when active construction work was resumed by Red Mountain Chromite, Inc., and later continued by the Alaska Road Commission.

Property and Ownership

The location of the principal deposits and claims is shown on figure 3. Ownership of the claims covering the principal known deposits at Red Mountain is as follows.

Patented claims	Holder	Deposit No.
Star No. 4	John W. Blodgett, Jr.	2
Juneau No. 1	do.	8
Juneau No. 2	do.	11
Unpatented claims		
Edith No. 1	do.	
Edith No. 2	do.	
Edith No. 3	do.	24
Edith No. 4	do.	1
Edith No. 5	do.	10
Edith No. 7	do.	17
Edith No. 8	do.	
Edith No. 9	do.	
Edith No. 10	do.	4
Edith No. 11	do.	3
Edith No. 12	do.	
Horse Shoe (placer)	do.	5
Charles Frances (placer)	do.	
Chrome Queen	Kearns & Cooper	23
Big Parade	do.	
Big Bend	do.	1/
Cliffside	do.	
Cawing Crow	do.	2/
Widow Maker	do.	2/
Cherokee Chief	do.	6

1 Formerly Barrister Lode No. 1.
2 Part of 9.

In October 1942, Red Mountain Chromite, Inc., stock was held as follows:

	Percent
John W. Blodgett, Jr.	75
K. E. Hamlin	20
J. R. McCusker	4
First National Bank of Portland	1
	100

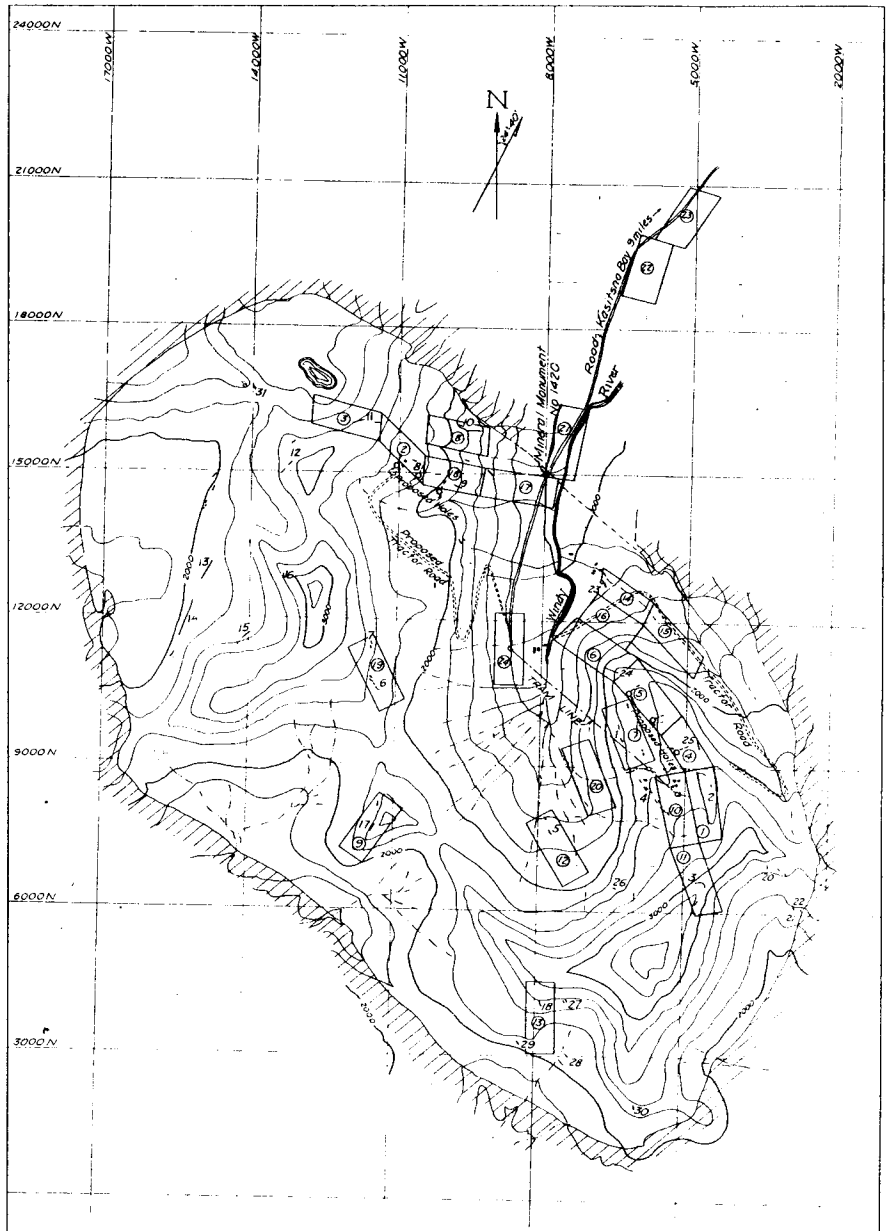


FIG. 3 GEOLOGIC AND TOPOGRAPHIC MAP, RED MTN, ALASKA

The patented and unpatented mining claims of Red Mountain Chromite, Inc., were purchased by John W. Blodgett, Jr., but in October 1942 there was no record of a lease or royalty agreement whereby Red Mountain Chromite, Inc., was to work the claims.

Kearns & Cooper is a partnership between Guy P. Kearns, Seldovia, Alaska, and Dawson Cooper, Fairbanks, Alaska. The holdings of Kearns & Cooper have been leased by the Chrome Queen Mining Co., which is a partnership composed of Herbert Miller, Robert Heath, and Ray Sharp, of Seldovia, Alaska.

R. E. L. Rutledge, Ketchikan, Alaska, holds several claims in the area, which have not been listed. Among the deposits covered by his claims are 7 and parts of Nos. 9, 12, and 14.

Parts of Windy River Valley are covered by placer claims held by Rutledge, Kearns, Cooper, and John W. Blodgett, Jr. The exact locations have not been surveyed.

ORE DEPOSITS

General Geology

"Chromite deposits occur at the south end of Kenai Peninsula, Alaska, in two areas — Claim Point and Red Mountain. They are contained in masses of ultramafic rocks (those with unusually large contents of magnesium and iron), which are intrusive into a complex series of graywackes, slates, and cherts of Paleozoic (?) age. Dunite is the predominant intrusive; pyroxenite, garnet pyroxenite, and serpentine derived from the alteration of dunite also are present.

"Chromite grains are distributed in small quantity throughout the dunite; the ore deposits are parts of the dunite and serpentine masses in which chromite has been concentrated by magmatic segregation. These deposits are tabular, strongly banded bodies, which range in size from stringers to bodies containing more than 50,000 tons and in grade from a few percent to 50 percent of chromic oxide (Cr_2O_3)." [4]

4 Guild, P. W., Page 139 of work cited in footnote 3.

Deposits 2, 3, and 24 (fig. 3) are assumed to be in one zone and 8, 9, and 11 in another or possibly in the same zone continued on the west side of Windy River Valley. Deposits 12, 13, and 14 assume the same relationship. There is a possibility that all these deposits are in the same zone. Deposits 10 and 23 occur in lower strata, which offer further possibilities for prospecting. These deposits occur in the center of the wider dunite bands. The larger deposits seem to occur in the steeply dipping part of the formation. Another characteristic of the ore bodies drilled is that the strike length is greater than the dip. The occurrences of ore bodies at fairly even intervals along the strike of a zone and also of long strike length compared to dip has been observed in other deposits of this type at John Day, Oreg.[5]

Mineralogy

The chromium-iron ratio of the chromite ore varies from 2.5:1 to 3.3:1. In general, analyses indicate that 40 percent shipping ore from most of the Red Mountain deposits will have a ratio of 2.7:1. Concentrates from detrital material from Claim Point and Red Mountain indicate that the iron content may be slightly higher.

Recent analyses by the Bureau of Mines of samples of olivine from Red Mountain show the presence of nickel and cobalt in appreciable quantities. As the nickel of New Caledonia occurs in a hydrous silicate mineral, garnierite, as incrustations and fracture filling in serpentine, the serpentinized contact zone at Red Mountain should be examined and tested for nickel.

Description of the Deposits

Chrome Queen Mining Co., Deposit No. 23.

Deposit 23 is on the Chrome Queen claim, which has been leased to the Chrome Queen Mining Co. by the owners, Kearns & Cooper. The deposit is just above the floor of the valley, on the east slope, at an altitude of 1,200 feet. (See fig. 3.) The outcrop

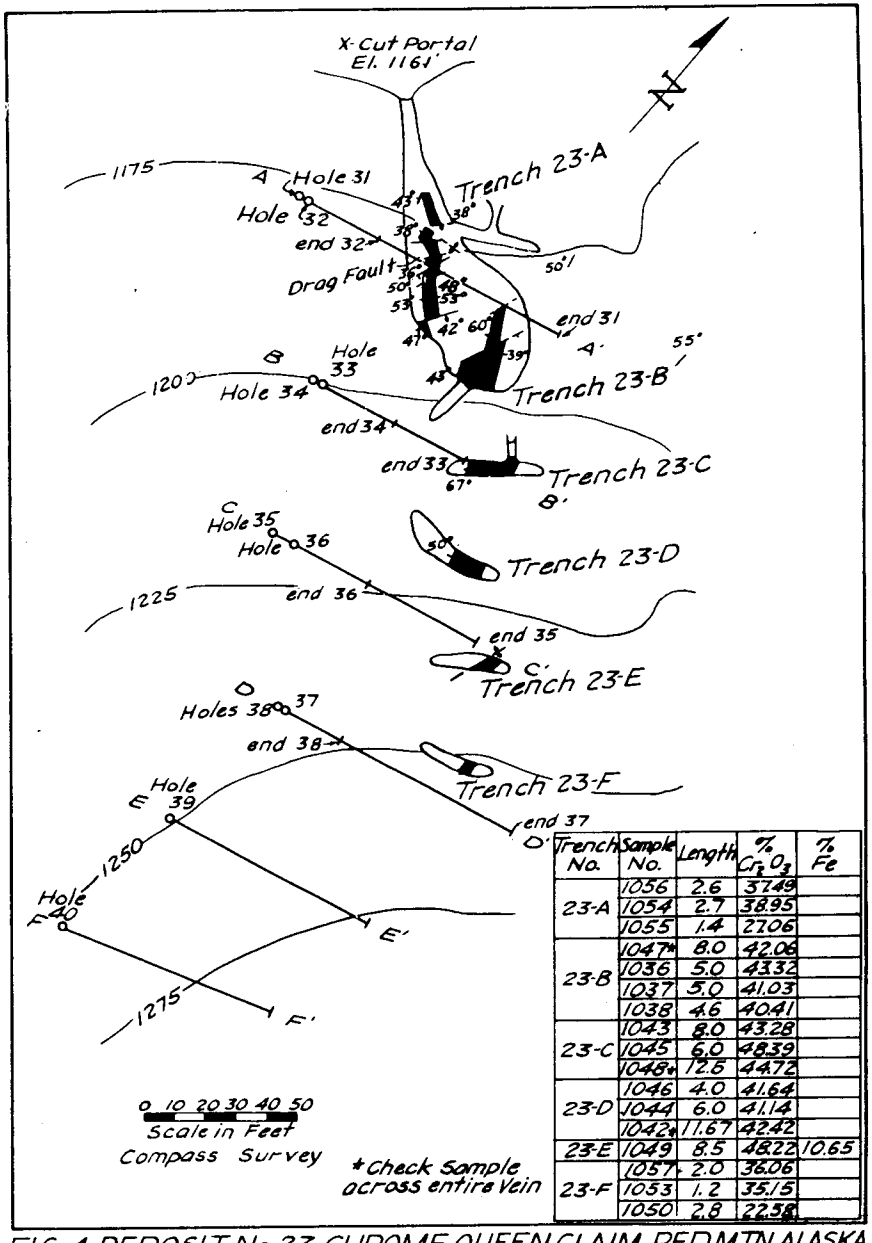
5 Unpublished Bureau of Mines report on chromite deposits of Grant County, Oregon, by O. Metzger.

was covered by approximately 6 feet of glacial moraine containing large boulders of high-grade chromite float. Trenching by G. F. Kearns exposed the ore at one location. Later trenching by the Bureau of Mines revealed a lenticular body of high-grade chromite ore striking N. 40° W. and dipping from 50° to 70° southwesterly. Ten core-drill holes, Nos. 31 to 40, inclusive, were sunk to explore this deposit. The ore intersected by holes 35, 37, 38, and 39 indicated a total of 7,786 long tons of shipping ore. (See logs of drill holes in figs. 4 through 10.)

Present operations. — The Chrome Queen Mining Co. obtained a $50,000 loan from the Reconstruction Finance Corporation to develop and mine the Chrome Queen ore body following exploration by the Bureau of Mines in 1941 and 1942. Since that time, approximately 368 feet of underground development has been completed, as follows: Crosscut, 33 feet; drift, 255 feet; and raises, 80 feet. More than 5,000 long tons of chromite ore has been produced and delivered to the Metals Reserve Co. purchasing depot on Jakolof Bay. Of this amount, 3,438 long tons had been analyzed and paid for on November 29, 1943, at an average net price of $36.52 a long ton. The $50,000 Reconstruction Finance Corporation loan has been liquidated from the proceeds of the sale of this ore.

Beyond the development necessary for the extraction of the measured ore body, the company has not engaged in any exploration or prospecting for faulted segments of the present ore body or for additional ore bodies. The company recessed operations for the winter early in November 1943 but expects to resume mining in the spring when climatic conditions are more favorable.

The Chrome Queen Mining Co. owns two tractors, one large compressor, drilling equipment, a generator, and a shop. Their camp consists of two bunkhouses, a kitchen and dining hall, one family dwelling, and a shop.



Trench No.	Sample No.	Length	% Cr_2O_3	% Fe
23-A	1056	2.6	37.49	
	1054	2.7	38.95	
	1055	1.4	27.06	
23-B	1047*	8.0	42.06	
	1036	5.0	43.32	
	1037	5.0	41.03	
	1038	4.6	40.41	
	1043	8.0	43.28	
23-C	1045	6.0	48.39	
	1048*	12.6	44.72	
23-D	1046	4.0	41.64	
	1044	6.0	41.14	
	1042*	11.67	42.42	
23-E	1049	8.5	48.22	10.65
23-F	1057*	2.0	36.06	
	1053	1.2	35.15	
	1050	2.8	22.58	

FIG. 4, DEPOSIT No. 23, CHROME QUEEN CLAIM RED MTN ALASKA

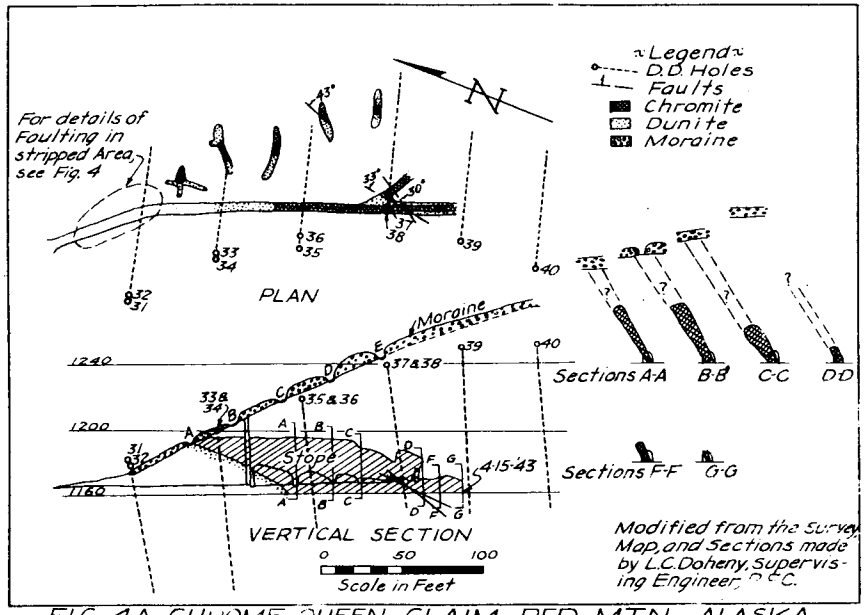


FIG. 4-A, CHROME QUEEN CLAIM, RED MTN., ALASKA

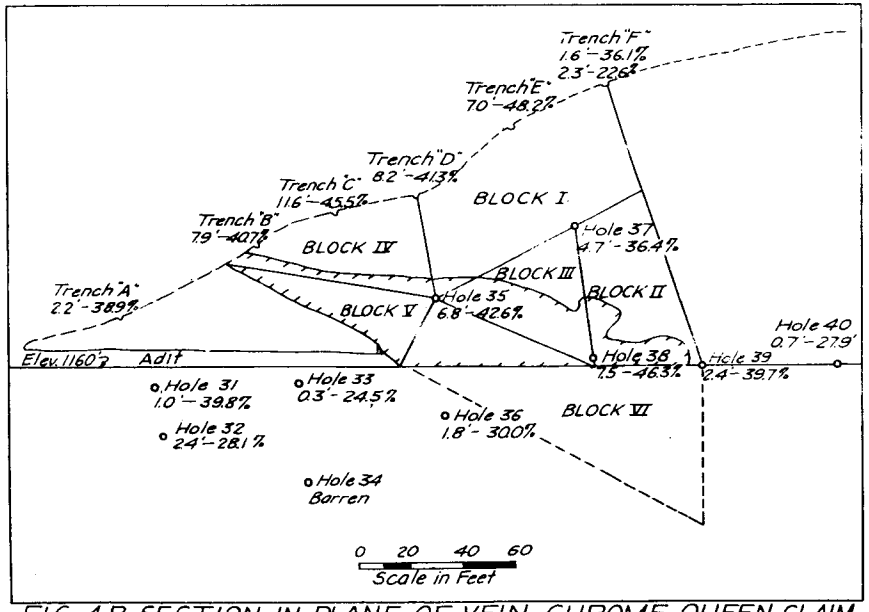
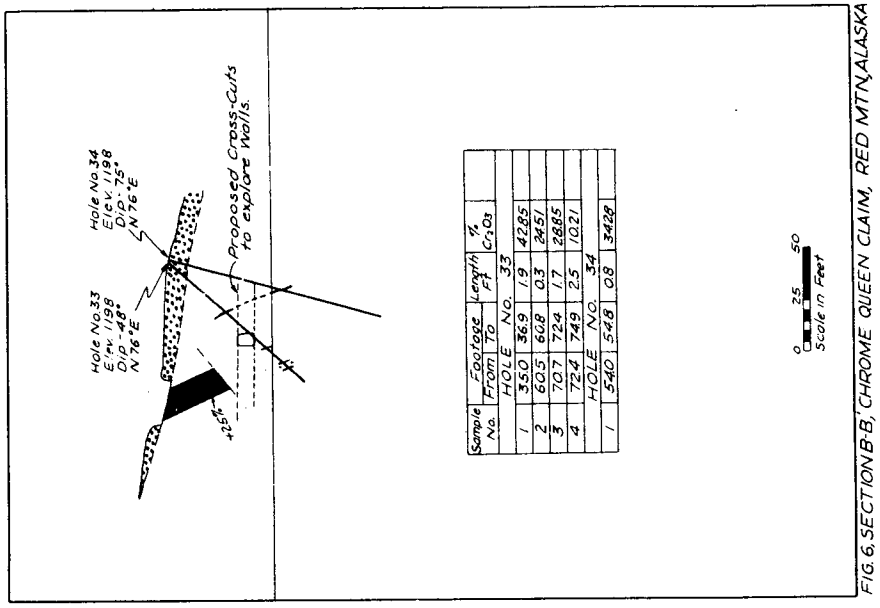
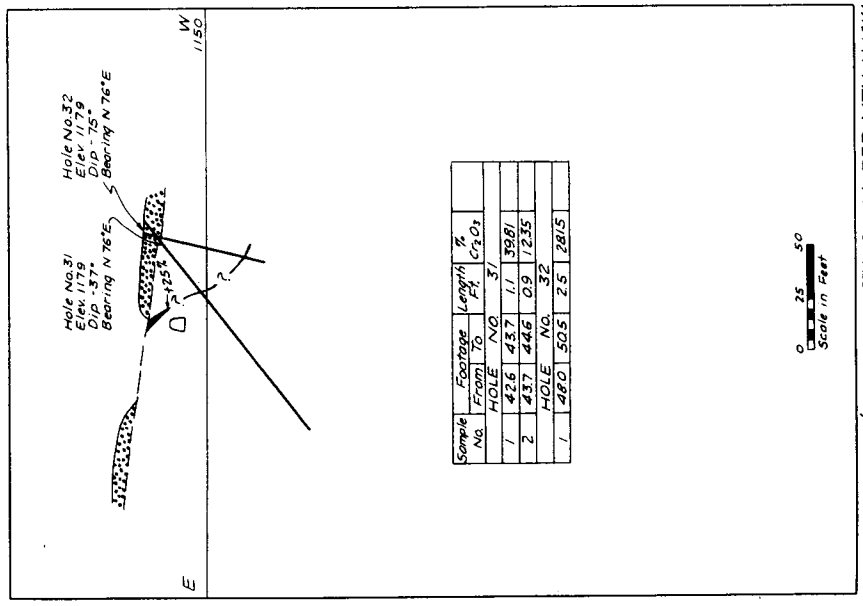


FIG. 4-B, SECTION IN PLANE OF VEIN, CHROME QUEEN CLAIM



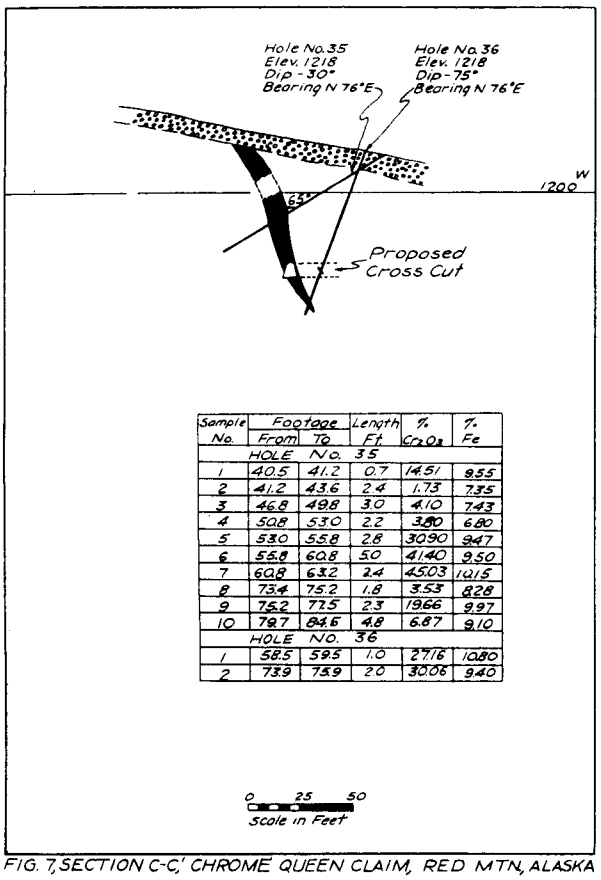
Sample No.	Footage From	To	Length Ft.	% Cr_2O_3
HOLE No. 33				
1	350	369	1.9	42.85
2	605	668	0.3	24.51
3	707	724	1.7	28.85
4	724	749	2.5	10.21
HOLE No. 34				
1	540	548	0.8	34.28

FIG. 6, SECTION B-B', CHROME QUEEN CLAIM, RED MTN, ALASKA



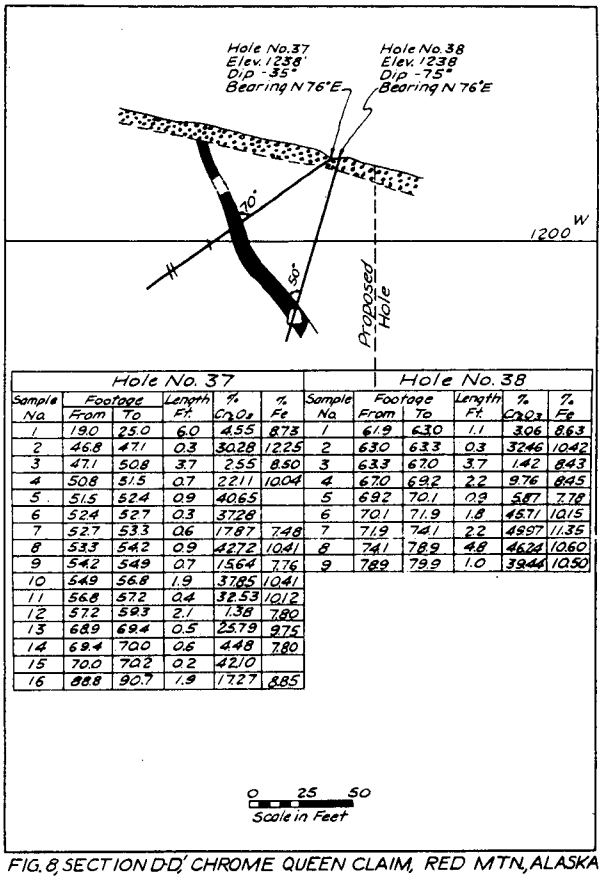
Sample No.	Footage From	To	Length Ft.	% Cr_2O_3
HOLE No. 31				
1	426	437	1.1	39.81
2	437	446	0.9	12.35
HOLE No. 32				
1	480	505	2.5	28.15

FIG. 5, SECTION A-A', CHROME QUEEN CLAIM, RED MTN, ALASKA



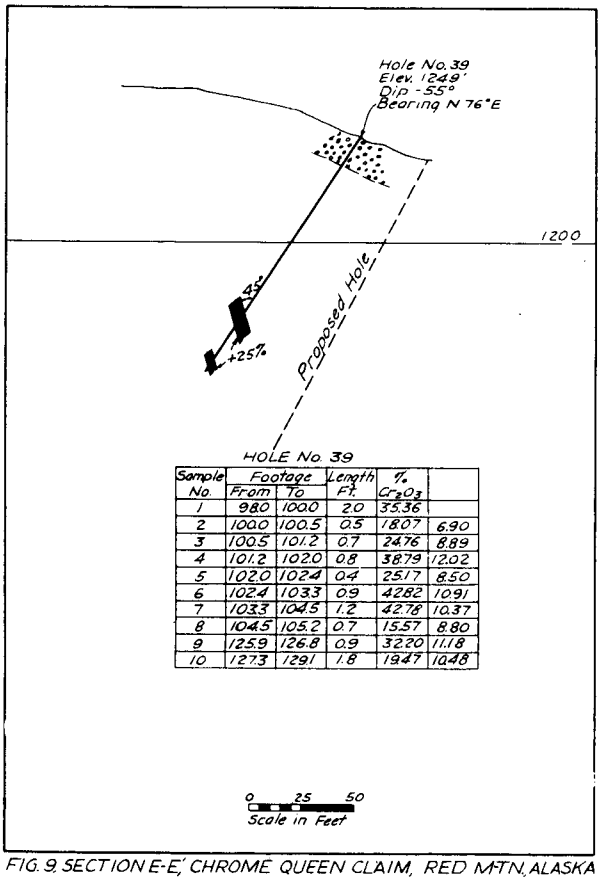
Sample No.	Footage From	Footage To	Length Ft.	% Cr_2O_3	% Fe
	HOLE No. 35				
1	40.5	41.2	0.7	14.51	9.55
2	41.2	43.6	2.4	1.73	7.35
3	46.8	49.8	3.0	4.10	7.43
4	50.8	53.0	2.2	3.80	6.80
5	53.0	55.8	2.8	30.90	9.47
6	55.8	60.8	5.0	41.40	9.50
7	60.8	63.2	2.4	45.03	10.15
8	73.4	75.2	1.8	3.53	8.28
9	75.2	77.5	2.3	19.66	9.97
10	79.7	84.6	4.8	6.87	9.10
	HOLE No. 36				
1	58.5	59.5	1.0	27.16	10.80
2	73.9	75.9	2.0	30.06	9.40

FIG. 7, SECTION C-C,' CHROME QUEEN CLAIM, RED MTN, ALASKA



Hole No. 37						Hole No. 38					
Sample No.	Footage From	Footage To	Length Ft.	% Cr_2O_3	% Fe	Sample No.	Footage From	Footage To	Length Ft.	% Cr_2O_3	% Fe
1	19.0	25.0	6.0	4.55	8.73	1	61.9	63.0	1.1	3.06	8.63
2	46.8	47.1	0.3	30.28	12.25	2	63.0	63.3	0.3	32.46	10.42
3	47.1	50.8	3.7	2.55	8.50	3	63.3	67.0	3.7	1.42	8.43
4	50.8	51.5	0.7	22.11	10.04	4	67.0	69.2	2.2	9.76	8.45
5	51.5	52.4	0.9	40.65		5	69.2	70.1	0.9	5.87	7.78
6	52.4	52.7	0.3	37.28		6	70.1	71.9	1.8	45.71	10.15
7	52.7	53.3	0.6	17.87	7.48	7	71.9	74.1	2.2	49.97	11.35
8	53.3	54.2	0.9	42.72	10.41	8	74.1	78.9	4.8	46.24	10.60
9	54.2	54.9	0.7	15.64	7.76	9	78.9	79.9	1.0	39.44	10.50
10	54.9	56.8	1.9	37.85	10.41						
11	56.8	57.2	0.4	32.53	10.12						
12	57.2	59.3	2.1	1.38	7.80						
13	68.9	69.4	0.5	25.79	9.75						
14	69.4	70.0	0.6	4.48	7.80						
15	70.0	70.2	0.2	42.10							
16	88.8	90.7	1.9	17.27	8.85						

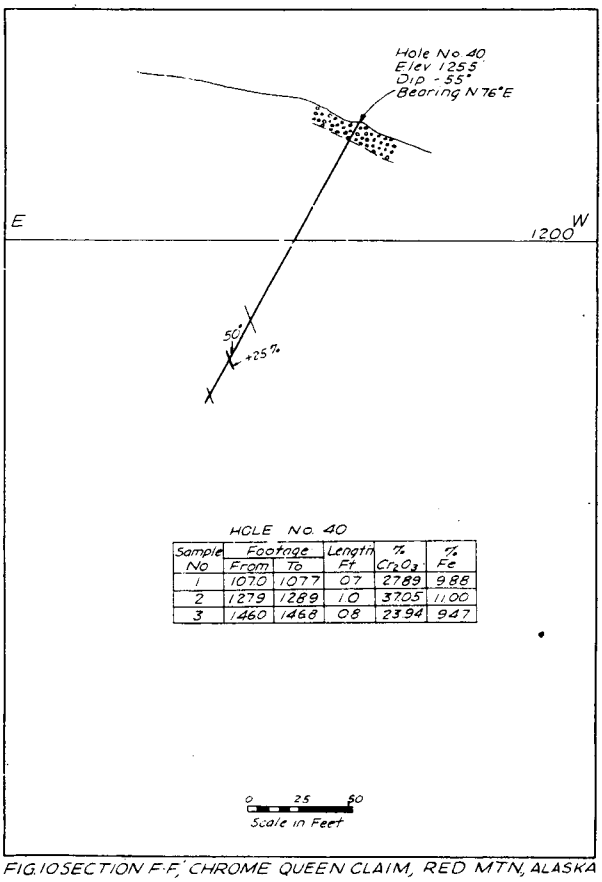
FIG. 8, SECTION D-D,' CHROME QUEEN CLAIM, RED MTN, ALASKA



HOLE No. 39

Sample No.	Footage From	Footage To	Length Ft.	% Cr_2O_3	
1	98.0	100.0	2.0	35.36	
2	100.0	100.5	0.5	18.07	6.90
3	100.5	101.2	0.7	24.76	8.89
4	101.2	102.0	0.8	38.79	12.02
5	102.0	102.4	0.4	25.17	8.50
6	102.4	103.3	0.9	42.82	10.91
7	103.3	104.5	1.2	42.78	10.37
8	104.5	105.2	0.7	15.57	8.80
9	125.9	126.8	0.9	32.20	11.18
10	127.3	129.1	1.8	19.47	10.48

FIG. 9, SECTION E-E,' CHROME QUEEN CLAIM, RED MTN, ALASKA



HOLE No. 40

Sample No	Footage From	Footage To	Length Ft.	% Cr_2O_3	% Fe
1	1070	1077	0.7	27.89	9.88
2	1279	1289	1.0	37.05	11.00
3	1460	1468	0.8	23.94	9.47

FIG. 10 SECTION F-F,' CHROME QUEEN CLAIM, RED MTN, ALASKA

Ore reserves as of December 1943. — Tonnage of ore in the Chrome Queen deposit has been calculated by the cross-section method on the basis of surface sampling, ore intersected in holes 35, 37, 38, and 39, and the results of underground development and stoping by the Chrome Queen Mining Co., as shown in figure 4B. The chromite intersected by the other holes is generally either too low-grade or too narrow to be minable. At the north end, the ore appears to terminate at a southward-dipping fault.

The ore in blocks I, II, III, IV, and V has been explored on two sides, and these blocks are classified as measured ore. Block VI is classified as indicated ore.

The calculation of the Chrome Queen ore reserves is shown in table 1.

TABLE 1. — Chrome Queen ore (estimate of January 1943)

Measured

Block	Average thickness, feet	Area, sq. ft.	Cubic feet	Long tons	Grade
I	5.87	3,544	20,803	2,359	43.1
II	4.87	2,040	9,935	1,126	42.0
III	6.33	1,430	9,052	1,026	42.5
IV	8.62	1,053	9,077	1,029	43.6
V	5.50	2,041	11,226	1,273	43.0
Total measured ore				6,813	42.9
Total mined, December 1943				5,000	
Ore remaining, December 1943				1,813	

Indicated

VI	2.6	3,300	8,580	973	43.0
Total Chrome Queen ore				2,786	42.9

Proposed work. — The Chrome Queen Mining Co. expects to resume mining operations in 1944 on the present ore body and should at that time initiate a program of exploration. Mining has been profitable, and the company is able to finance this exploration. The faulted segment of the Chrome Queen deposit should be located and developed by surface trenching and crosscuts from the present tunnel. A chromite outcrop 225 feet southwest of the tunnel was exposed during road construction; this should be trenched, and, if results are encouraging, underground development should follow. The indicated ore beneath the present tunnel also should be developed and mined.

Kearns & Cooper, Deposit No. 9

This deposit is on the Widow Maker claim (owned by Kearns & Cooper) and includes several ore bodies that outcrop on the steep west wall of the Windy River cirque. The altitude of this ore body is 1,200 to 1,900 feet, and it strikes N. 70° W. and dips 40° southwest. It consists of several bands of low-grade chromite, the principal one being a lenticular vein of evenly disseminated chromite 3 feet wide at the center and 200 feet long. Seven samples were cut, as follows:

Sample	Width	Percent Cr_2O_3	Percent Fe
18*	1.7	27.20	7.7
19*	1.9	36.89	8.7
1032	4.6	13.74	
1033	3.9	14.54	
1031*	2.7	25.64	
1034	4.5	17.72	
1035*	2.9	38.08	

* Samples taken from principal body. Sum of widths of samples 18 and 19 equals total width.

Samples 1032 to 1034, inclusive, were cut from a longer and wider parallel band of chromite mineralization. Other larger bands were noted but not sampled, which are estimated to contain 10 percent Cr_2O_3. This deposit has not been developed.

Ore reserves. — The tonnage and weighted assay indicated by samples 18, 19, 1031, and 1035 is 2,400 long tons of chromite ore averaging 32.2 percent Cr_2O_3. The samples were cut from an ore exposure 200 feet long and averaging 2.2 feet in width. The tonnage is based upon an assumed depth of 50 feet.

The tonnage and weighted assay indicated by samples 1032, 1033, and 1034, which were cut from a second ore body 200 feet long by 4.2 feet wide for an assumed depth of 50 feet, is 4,600 long tons of chromite ore at 15.36 percent Cr_2O_3.

The tonnage and weighted assay of the two ore bodies is 7,000 long tons of 21.1 percent chrome oxide.

Samples 18, 19, 1031, and 35 were cut from an ore exposure 200 feet long and having a width of 2.2 feet. The weighted assay of these samples indicates that the ore will average 32.2 percent Cr_2O_3. Assuming the ore body has a depth of 50 feet, there is indicated 2,400 long tons of ore in this lens that will average 32.2 percent Cr_2O_3.

Samples 1032, 1033, and 1034 were cut from a second ore body, and the weighted average of these samples was 15.36 percent Cr_2O_3. This ore body is 200 feet long and has an average width of 4.2 feet. Assuming the ore body has a depth of 50 feet, there is indicated 4,600 long tons of ore with an average grade of 15.36 percent Cr_2O_3. In the two ore bodies, there are 7,000 long tons of ore that will average approximately 21 percent Cr_2O_3.

Proposed work. --At least one hole should be drilled to test the Widow Maker deposit at depth. Only 7,000 long tons of milling ore are classified as inferred in this deposit. There are several parallel zones of mineralization that have possibilities of developing a fairly large tonnage of 15-percent ore. This ore would be minable if a mill is constructed in the area.

RED MOUNTAIN CHROMITE, INC., PROPERTIES

Four deposits (Nos. 2, 8, 11, and 24) have been explored by the Bureau of Mines and are described as follows:

Deposit 2

This is one of the largest single deposits of high-grade chromite known in North America. It is on the Star No. 4 claim on the comparatively level plateau north of Red Mountain at an altitude of 2,600 feet. It is a tabular ore body, the main part of which is 622 feet long with a maximum width of 10 feet at the outcrop. It strikes N. 10° W. and dips 45° west. The outcrop is

seen as a stringer of chromite 180 feet south of the discovery pit, which gradually widens to the north to a maximum thickness of 10 feet of high-grade chromite at the discovery pit and tapers to 2.5 feet in thickness at a point 220 feet farther north. Two narrow footwall veins start 80 feet north of the pit and continue to the same point. Although the vein is thought to be continuous beyond this point, intense folding makes it difficult to measure the thickness again until a point is reached 360 feet from the discovery pit, where the outcrop consists of four high-grade bands separated by dunite. These bands continue for 100 feet to the north, where chromite appears in a 1-foot lenticular vein 80 feet in length and then as another 1-foot vein 300 feet in length. The total length of the outcrop is 1,100 feet. South of the discovery pit are numerous transverse faults that dip steeply to the south. The maximum horizontal movement is 10 feet. Nine holes were drilled and numbered from 41 to 49, inclusive. Drill hole 41 indicates that the ore body increases in width to 12.2 feet at a point 75 feet below the widest part of the outcrop. Below this point, the vein decreases in width and tapers off into low-grade stringers. Figures 11 through 18 show plan and sections of this deposit and analyses of the samples.

Development

At the No. 2 deposit, a 490-foot adit was driven, which intersected the ore body at an elevation of 2,457 feet. Before the operation was recessed, 195 feet of drifting was completed along the vein (fig. 11). The camp at the Star No. 4 deposit was dismantled in October 1943, and the material was hauled down the 2.2-mile tractor road to the Windy River Valley and stored.

It is possible to exploit this deposit along either of two lines: (1) By the production of shipping ore only or (2) by milling in conjunction with the production of shipping ore. Reserves applicable to each plan have been calculated.

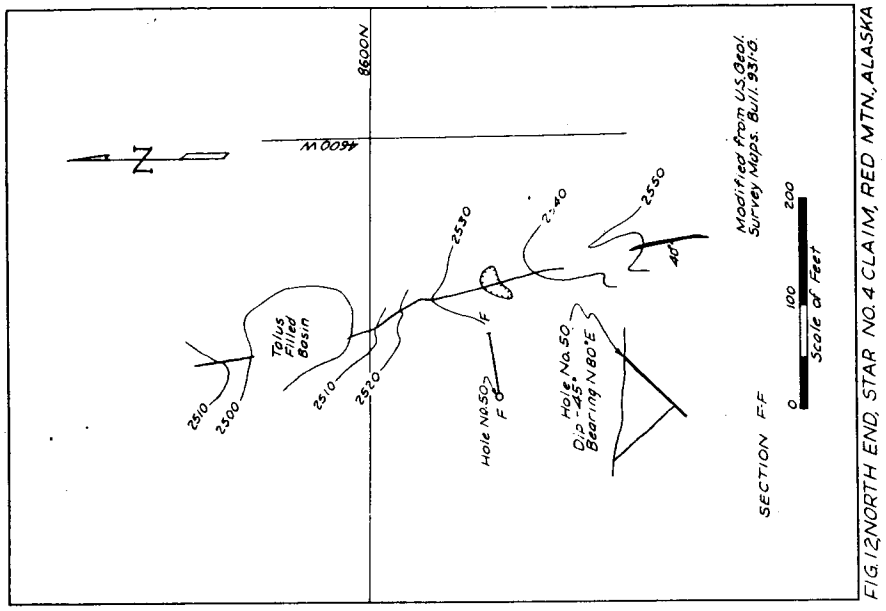


FIG.12 NORTH END, STAR NO. 4 CLAIM, RED MTN, ALASKA

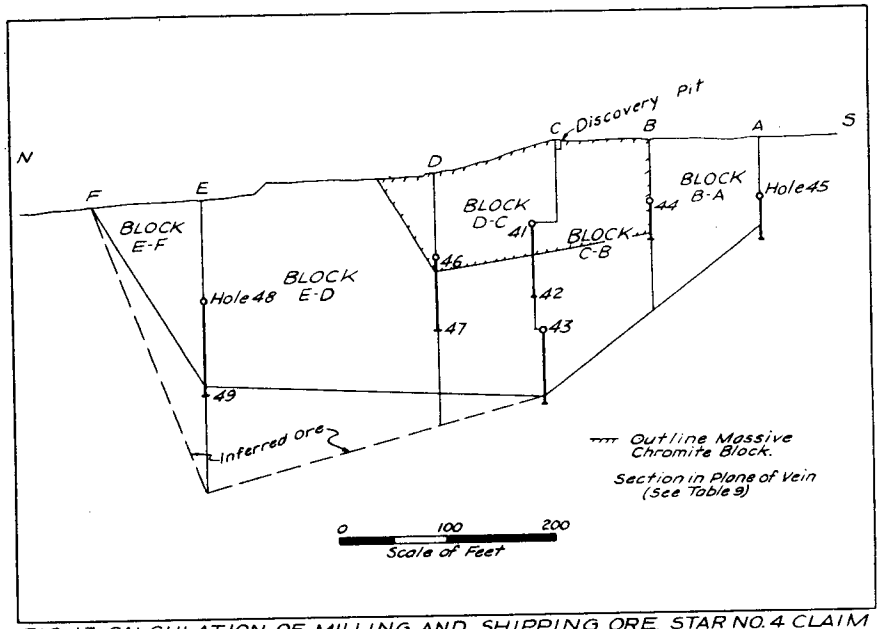


FIG. 13 CALCULATION OF MILLING AND SHIPPING ORE, STAR NO. 4 CLAIM

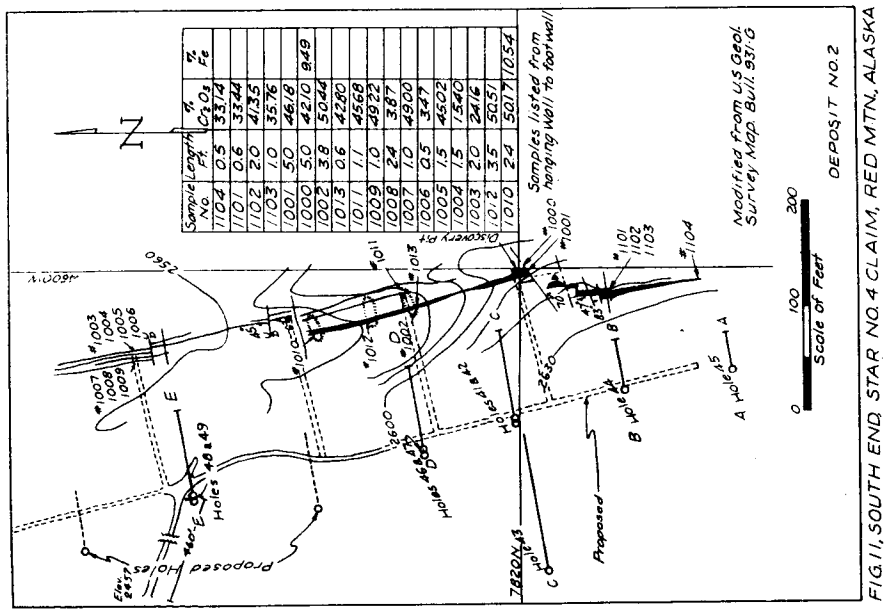


FIG.11, SOUTH END, STAR NO. 4 CLAIM, RED MTN, ALASKA

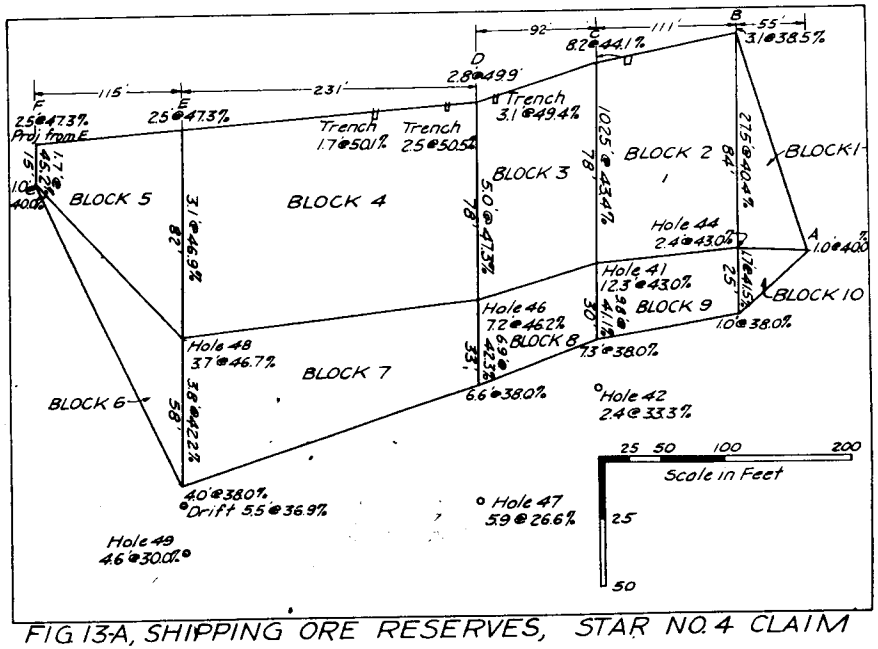
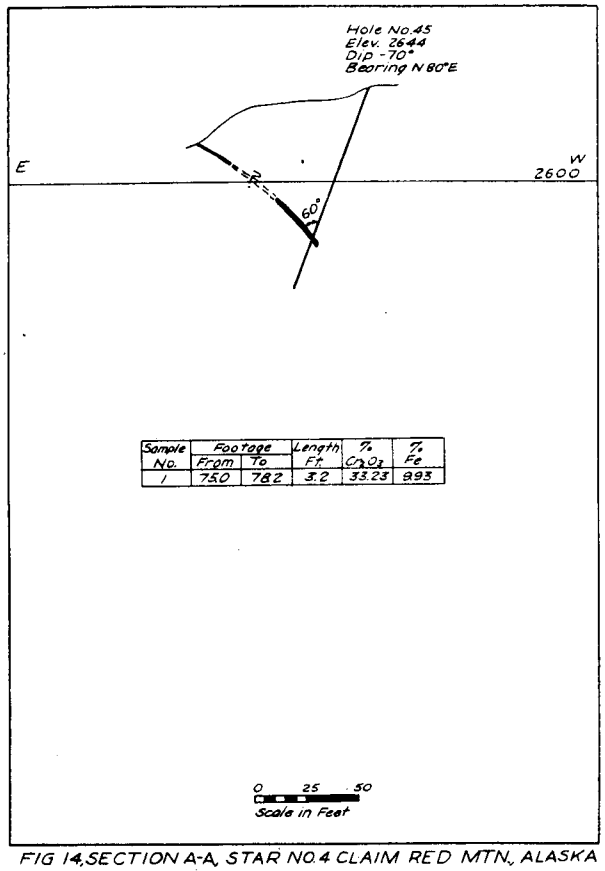
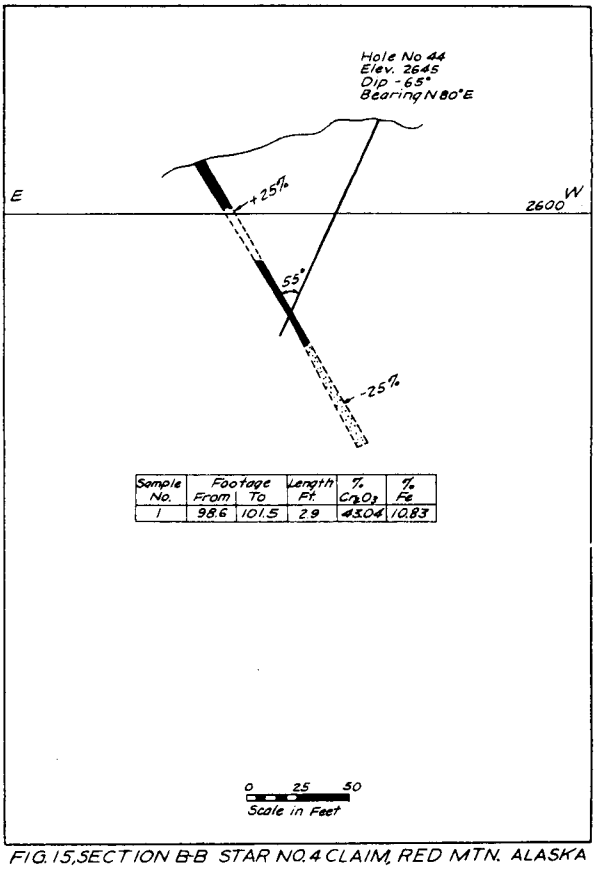


FIG 13-A, SHIPPING ORE RESERVES, STAR NO. 4 CLAIM



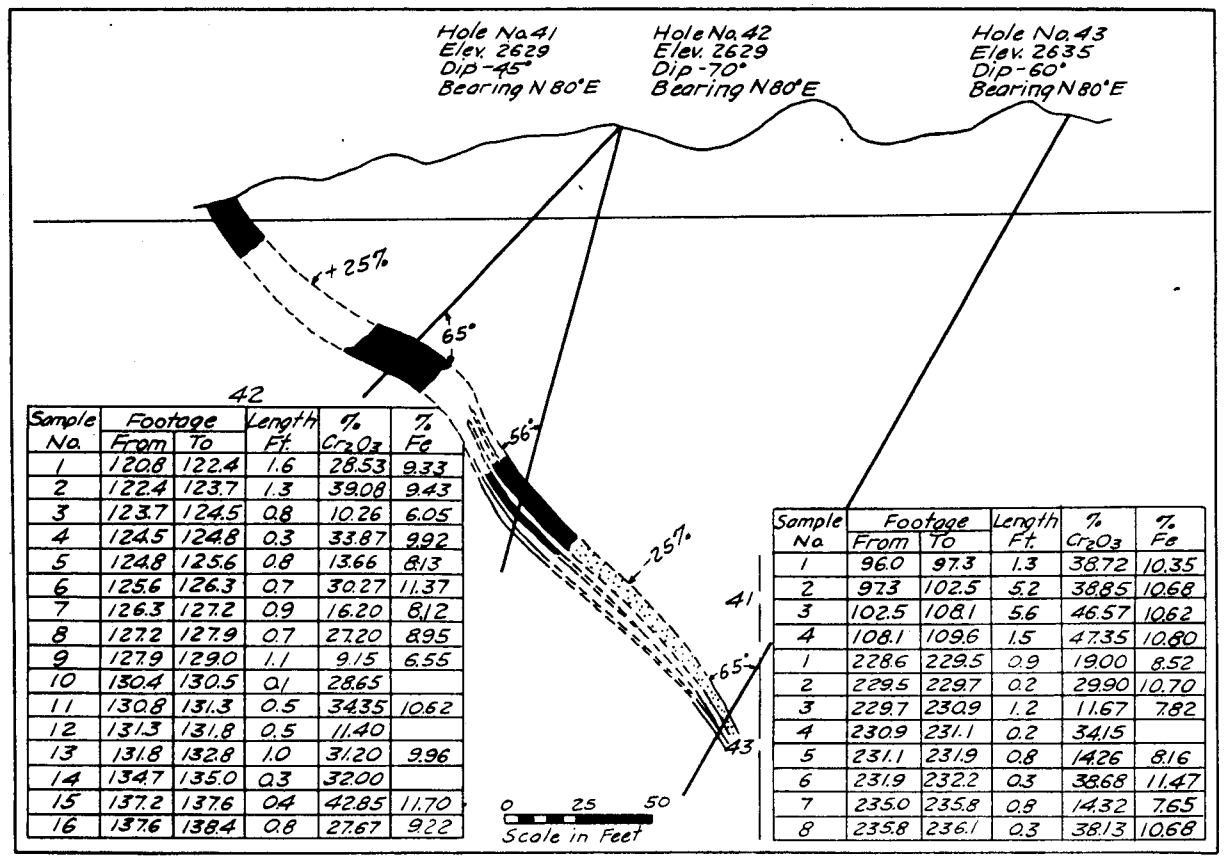
Sample No.	Footage From	Footage To	Length Ft.	% Cr_2O_3	% Fe
1	75.0	78.2	3.2	33.23	9.93

FIG 14, SECTION A-A, STAR NO.4 CLAIM RED MTN, ALASKA



Sample No.	Footage From	Footage To	Length Ft.	% Cr_2O_3	% Fe
1	98.6	101.5	2.9	43.04	10.83

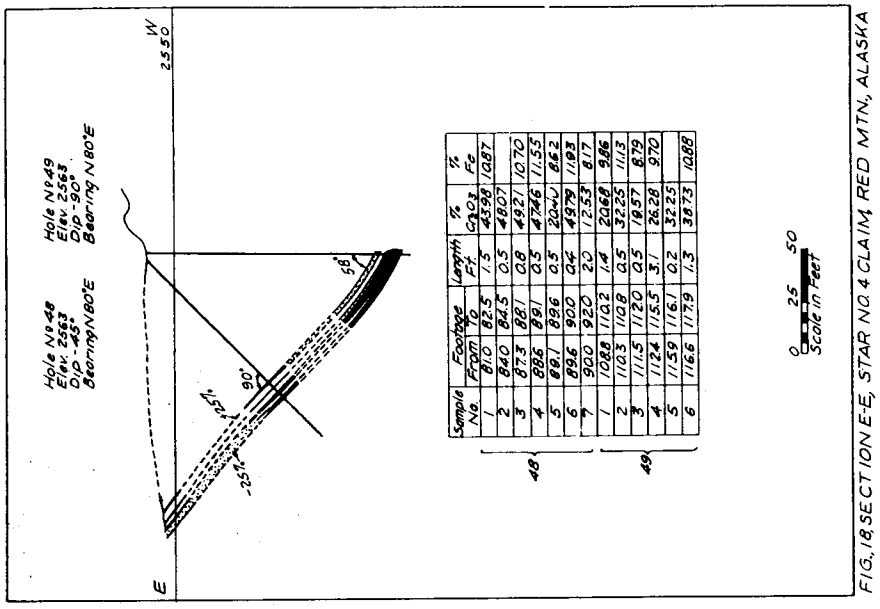
FIG. 15, SECTION B-B STAR NO. 4 CLAIM, RED MTN. ALASKA



Sample No.	Footage From	Footage To	Length Ft.	% Cr_2O_3	% Fe
1	120.8	122.4	1.6	28.53	9.33
2	122.4	123.7	1.3	39.08	9.43
3	123.7	124.5	0.8	10.26	6.05
4	124.5	124.8	0.3	33.87	9.92
5	124.8	125.6	0.8	13.66	8.13
6	125.6	126.3	0.7	30.27	11.37
7	126.3	127.2	0.9	16.20	8.12
8	127.2	127.9	0.7	27.20	8.95
9	127.9	129.0	1.1	9.15	6.55
10	130.4	130.5	0.1	28.65	
11	130.8	131.3	0.5	34.35	10.62
12	131.3	131.8	0.5	11.40	
13	131.8	132.8	1.0	31.20	9.96
14	134.7	135.0	0.3	32.00	
15	137.2	137.6	0.4	42.85	11.70
16	137.6	138.4	0.8	27.67	9.22

Sample No.	Footage From	Footage To	Length Ft.	% Cr_2O_3	% Fe
1	96.0	97.3	1.3	38.72	10.35
2	97.3	102.5	5.2	38.85	10.68
3	102.5	108.1	5.6	46.57	10.62
4	108.1	109.6	1.5	47.35	10.80
1	228.6	229.5	0.9	19.00	8.52
2	229.5	229.7	0.2	29.90	10.70
3	229.7	230.9	1.2	11.67	7.82
4	230.9	231.1	0.2	34.15	
5	231.1	231.9	0.8	14.26	8.16
6	231.9	232.2	0.3	38.68	11.47
7	235.0	235.8	0.8	14.32	7.65
8	235.8	236.1	0.3	38.13	10.68

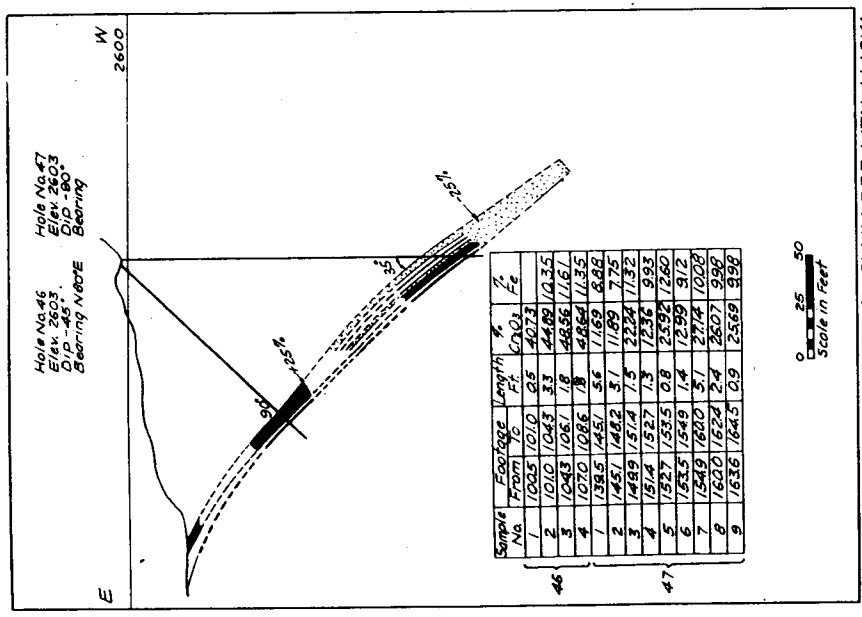
FIG. 16, SECTION C-C, STAR NO. 4 CLAIM RED MTN., ALASKA



Sample No.	Footage From	Footage To	Length Ft.	% CaO₂	% Fe
1	810	825	1.5	43.98	10.87
2	840	845	0.5	48.07	
3	873	881	0.8	49.21	10.70
4	886	891	0.5	47.46	11.55
5	891	896	0.5	20.40	8.62
6	896	900	0.4	49.79	11.63
7	900	920	2.0	12.53	8.17
1	1088	1102	1.4	20.68	9.86
2	1103	1108	0.5	32.25	11.13
3	1115	1120	0.5	18.57	8.79
4	1124	1155	3.1	26.28	9.70
5	1159	1161	0.2	32.25	
6	1165	1179	1.3	38.73	10.88

48 49

FIG. 18 SECTION E-E, STAR NO 4 CLAIM, RED MTN, ALASKA



Sample No.	Footage From	Footage To	Length Ft.	% CaO₂	% Fe
1	1005	1010	0.5	40.73	
2	1010	1043	3.3	44.89	10.35
3	1043	1061	1.8	46.56	11.61
4	1070	1086	1.8	48.64	11.35
1	1395	1451	5.6	11.69	8.88
2	1451	1482	3.1	11.89	7.75
3	1499	1514	1.5	22.24	11.32
4	1514	1527	1.3	12.36	9.93
5	1527	1535	0.8	23.92	12.60
6	1535	1549	1.4	12.99	9.12
7	1549	1600	5.1	27.14	10.03
8	1600	1624	2.4	25.07	9.98
9	1636	1645	0.9	25.69	9.98

46 47

FIG 17, SECTION D-D, STAR NO 4 CLAIM RED MTN, ALASKA

It is believed that enough equipment is available to mine the shipping-grade ore. There are no permanent mining-equipment installations. Diesel and gasoline-powered portable compressors and generators are used and probably will be the most economical power for a mill. Enough water flows in Windy River to develop necessary power at a site about 2 miles below the area. The cost of installing a hydro-electric system would be great and its justification questionable.

Red Mountain Chromite, Inc., equipment includes 6 tractors equipped with blades, 4 1½-ton trucks, power shovel, road grader, 3 small and 2 large portable compressors, drilling equipment, shop, laboratory, and 1 mile of 2-cable tramway.

Red Mountain Chromite, Inc., buildings include a combination steel bunkhouse and kitchen, 4 or 5 family dwellings, a warehouse at the mouth of Jakolof Bay, and 6 half-cylindrical steel buildings for a camp on the Star No. 4 claim. The Bureau of Mines has one 12- by 20-foot frame building in Windy River Valley.

Red Mountain Chromite, Inc., started construction of a road from Jakolof Bay to their claims at Red Mountain in July 1941. During 1943, this road was completed by the Alaska Road Commission, an access-road appropriation of $95,000 having been used for the purpose. Congress appropriated access-road funds under section 6, Defense Highway Act, 1941 (55 Stat., 765). The road is from the dock on Kasitsna Bay, along the shore of Jakolof Bay, to the foot of Red Mountain. This dock, completed by the company in 1942, was almost completely destroyed by "teredo" worms during the subsequent 8 months. It was constructed of local untreated timber, the piling having been driven butts up. Docks in the Cook Inlet area must be built of creosoted timber.

Operations at the No. 2 deposit are hampered considerably by climatic conditions. The snowfall on Red Mountain is very heavy, and the wind frequently reaches a velocity of 90 miles an hour

during the period from October to June. Two glaciers within a few miles of the upper camp indicate the rapid accumulation of snow in the area. Prevailing southeasterly to southwesterly winds subject the property to the fog, rain, and snow brought in from the Gulf of Alaska. In January 1943, a tram tower that had just been completed collapsed in the middle as the result of high winds. It was well-anchored at the bottom and was secured with guy cables at the top. On April 17, 1943, the snow was over 18 feet deep at the upper campsite. Its weight, owing to the high moisture content, was 18.6 pounds per cubic foot. The Quanset huts were buried completely, and, despite reinforcing from the inside, the roofs failed.

Ore Reserves

The indicated shipping ore consists of blocks 2, 3, and 4, and inferred shipping ore of the remaining seven blocks is shown in figure 13-A. In projecting the boundaries of inferred shipping ore below or beyond points of determined grade, the rates of change in both grade and width applied are those indicated within the section.

Successively deeper determinations in each section show a decrease in grade, except in section B. In projecting shipping ore downward in this section, as well as to the south, liberal decreases in grade and width have been allowed. Section F has been projected northward half the distance between the two preceding sections. In section E, the downward projection has been carried below the cut-off point, as indicated by the rate of decrease in grade between holes 48 and 49. It has been determined by grade determinations in the drift that cuts the section at an elevation of 2,457 feet.

It is evident that some sorting will be required to produce shipping ore, particularly in the northern part of the deposit.

Widths less than 4 feet will necessitate resuing. (Stoping method in which wall rock on one side of the vein is removed before ore is broken.)

The deposit is estimated to contain 35,387 long tons of shipping ore having an average grade of 44 percent Cr_2O_3, as detailed in table 2.

TABLE 2. — Indicated shipping ore, Star No. 4 claim

Block	Average thickness, ft.	Area, sq. ft.	Cubic feet	Long tons	Grade
1	2.2	2,310	5,082	576	40.4
2	6.4	8,991	57,542	6,524	42.8
3	7.5	7,176	54,537	6,183	44.7
4	4.0	18,480	73,920	8,381	47.2
5	2.9	5,575	16,167	1,833	46.3
6	2.9	3,335	9,671	1,096	41.8
7	4.9	10,510	51,499	5,840	42.3
8	8.3	2,898	24,053	2,727	41.6
9	6.1	3,052	18,617	2,110	41.2
10	1.5	687	1,030	117	41.2
	5.0	63,014	312,118	35,387	44.0

If a mill is installed, the entire No. 2 deposit, containing 111,174 long tons, could be mined. It would yield an estimated 47,130 long tons of shipping ore containing 41.74 percent Cr_2O_3 and 44,044 long tons of mill feed with a Cr_2O_3 content of 19.14 percent.

Ore reserves, on the basis of a milling operation, have been calculated by the cross-section method. With the exception of sections B and D, the ore has been assumed to terminate at the deepest holes. The part of sections B and D below holes 44 and 47 has been interpolated between holes 43, 45, and 49 (fig. 13). The ore is assumed to end at section A to the south and to taper out 100 feet north of section E. Assuming that the ore decreases in grade and width as rapidly under hole 49 as between holes 48 and 49, a block of inferred ore is indicated under hole 49. Hole 50 did not intersect ore of minable width, so no tonnage has been calculated in the long, single stringers that comprise the end

north of the ore body, as shown in figure 12. The possibility of recovering the high-grade ore in the narrow bands was considered in the sampling, the core samples having been divided according to the banding. It is estimated that 14,740 tons of 45 percent Cr_2O_3 ore can be mined directly with a minimum of sorting waste. Production of the remaining high-grade and milling ore will depend on hand sorting.

A minimum stoping width of 5 feet was assumed in calculating the total ore sections. The grade of the waste is estimated at 3 percent Cr_2O_3. The tonnage of waste is assumed to be the difference between total tonnage of ore mined and the tonnage of plus 10-percent ore. The length of core samples was corrected to actual vein width. The sum of the widths of the various bands intersected in each hole that assayed above the cut-off grade was used for calculating the volume of ore. The sum of the widths of the individual bands times the assay of the band was multiplied by the dip length to give square feet times assay. From this product, the volume-assay product was calculated by multiplying the average area-assay product of adjacent sections by the distance between. Total cubic feet times assay was divided by a tonnage factor of 8.82 cubic feet per long ton to give the grade of ore. (See p. 39.)

A break-down of the various grades of ore produced in mining a total of 111,174 long tons at the Star No. 4 deposits is shown in table 3.

TABLE 3. — Summary of products

	Long tons	Crude ore mined, percent	Cr_2O_3, percent
Ore mined clean.	14,740	13	45.00
Ore sorted	*32,390	29	40.26
Milling ore.	44,044	39	19.14
Waste sorted	20,000	19	3.00
Total ore to be mined. .	111,740	100	25.82

* Mining cut-off, 27 percent Cr_2O_3.

Proposed Work

Red Mountain Chromite, Inc., proposes to drive a 2,000-foot tunnel and 1,200 feet of raise from the Windy River Valley to provide for year-around operation of the Star No. 4 deposit. According to John Blodgett, Jr., the company plans to do additional core drilling before undertaking this development. One hole is to intersect the ore zone at 2,420 feet, halfway between sections D and E, and one hole is to intersect the ore zone at 2,420 feet, 100 feet north of section E, to prove the inferred milling ore. (Fig. 11.) However, Blodgett has advised the Bureau of Mines that a loan must be obtained before any additional work can be started.

Deposit 24

This deposit is on the Edith No. 3 claim and outcrops at 2,100 to 2,300 feet altitude at the top of the cliffs above the Chrome Queen mine and about 1,500 feet north of the Star No. 2 deposit. It consists of bands of high-grade and low-grade chromite separated by barren dunite. The upper band is 130 feet long, 4½ feet thick in the center, and decreases in thickness toward the ends. The middle band is 300 feet long and 1 to 4 feet thick. The lower band is only 70 feet long and less than 1 foot thick. According to Guild,[6] the deposit strikes N. 35° W. and dips 30° southwest. Analyses of trench samples taken on this deposit are shown in figure 19. Inferred reserves are estimated at 2,800 long tons of 44.6 percent Cr_2O_3 and 1,000 long tons of 31 percent Cr_2O_3 ore.

Deposit 11

This deposit is on the Juneau No. 2 claim and outcrops on the high ridge that forms the divide between Windy River and Fish Creek. At this point, the ridge has two crests, about 150 feet apart, divided by a shallow basin. Chromite outcrops on both crests,

6 Guild, P. W., Chromite Deposits of Kenai Peninsula, Alaska. In Strategic Minerals Investigations, 1941: Geol. Survey Bull. 931 (g), 1942, p. 173.

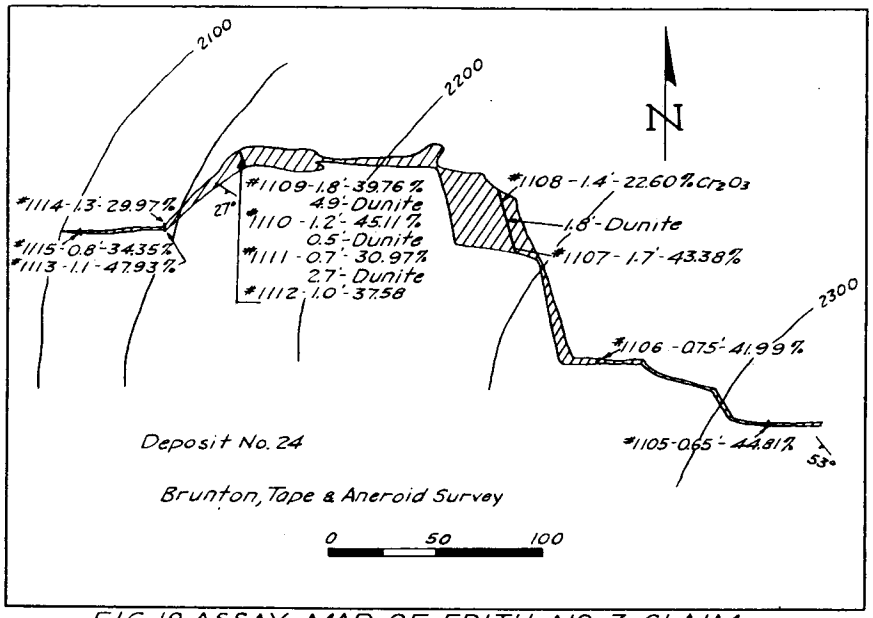


FIG. 19, ASSAY MAP OF EDITH NO. 3 CLAIM

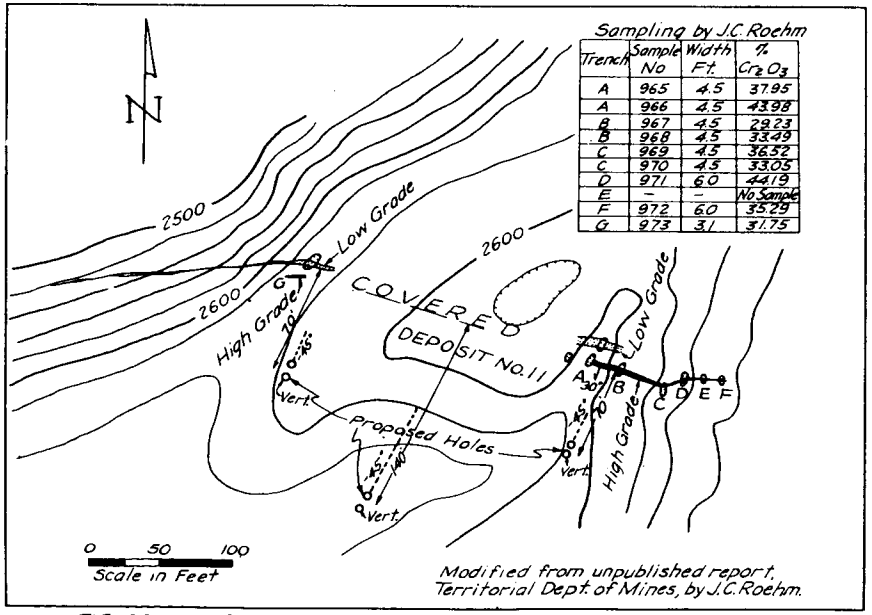


FIG. 20, JUNEAU NO. 2 CLAIM, RED MTN., ALASKA

but it has not been traced between them because of the talus cover. The deposit on the east crest strikes N. 85° W. and dips 30° south. It consists of 4½ feet of shipping-grade ore on the hanging wall and 4½ feet of slightly lower-grade on the footwall for a distance of 53 feet east, where it pinches to 6 feet in width. This zone maintains this width for a distance of 47 feet, then pinches to 2 feet and disappears beneath the talus. The deposit can be traced down the east side of the ridge 100 feet horizontally and 60 feet vertically. The ore averages 37 percent Cr_2O_3 over an average width of 7.7 feet. This deposit is separated by 5 feet of dunite between the parallel zones of concentrating ore, which have a combined average width of 7.7 feet. On the west side of the ridge, a low-grade zone averaging about 2 feet in thickness can be traced for several hundred feet. A plan of this deposit is shown on figure 20. No drilling has been done on this deposit. Based upon trench sampling and an assumed depth of 25 feet, this deposit contains 2,180 long tons of inferred ore averaging 37 percent Cr_2O_3.

Proposed Work

Four holes are planned to intersect the ore body along the strike: Two are to be drilled at an angle of 45° to cut the vein at a depth of 50 feet, and 2 holes are to cut the vein at a depth of 100 feet. (Fig. 20.)

If favorable results are obtained from the above holes, two additional holes will be drilled in the general center of the 4 holes to intersect the vein at 75 feet and 200 feet.

Outcrops across the two parallel ridges are separated by a shallow depression filled with detrital material. By using a bulldozer to clear this material, it is believed that the proven strike length can be increased. This, together with the proposed core drilling, may indicate substantial reserves of shipping ore.

Deposit 8

This deposit is on the patented Juneau No. 1 claim owned by John W. Blodgett, Jr. It is on a narrow plateau 3,000 feet west of Windy River and 1,500 feet southwest of the dunite contact at an elevation of 2,250 feet.

The general trend of the ore body is N. 65° W., although one warped or faulted block that outcrops strikes S. 60° W. The dip ranges from 48° to 59° southwest. The ore body has been exposed and sampled in four shallow trenches for a length of 85 feet and average width of 8 feet (fig. 21).

The ore appears to terminate abruptly to the west from either faulting or pinching, and it tapers off at the east end. The overburden is shallow, and there is no vegetation. Analysis of samples and ore-reserve calculations of this deposit are shown in figure 21.

The reserves inferred by surface trenching are 1,620 long tons of ore averaging 38.6 percent Cr_2O_3.

Deposit 8 appears to be one of the more important ore bodies and warrants further exploration.

Proposed Work

Three 100-foot holes are to be spaced at 50-foot intervals along the strike to intersect the ore at a depth of 500 feet (fig. 21). An additional hole is planned if the results of the three plotted holes are favorable. Additional trenching is justified at this deposit, particularly on the southeastern projection, to determine the location and cause of ore termination.

A trail or road will be needed for access to this deposit (fig. 3). A foot trail to be used during drilling operations would cost about $3,500. A tractor trail will be needed for mining and, if built before the drilling is started, will reduce the cost of drilling considerably. One mile of 15 percent-grade tractor trail

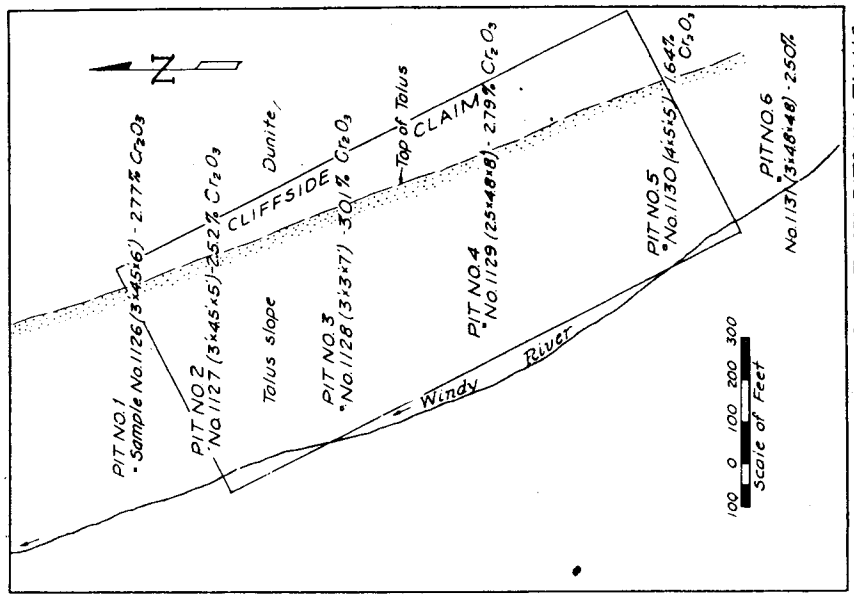
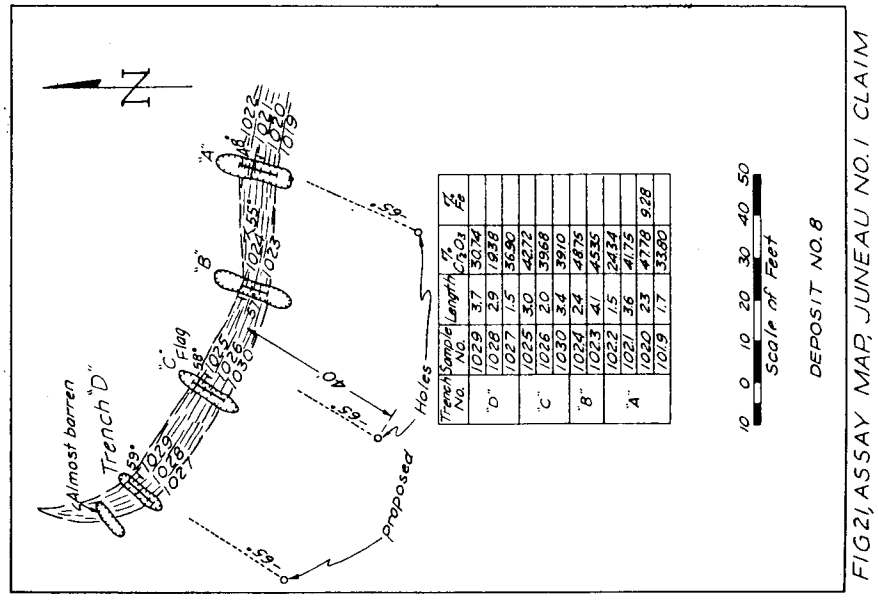


FIG. 22. SKETCH MAP OF TEST PITS IN TALUS



Trench No.	Sample No.	Length Ft.	Cr_2O_3 %	Cr_2O_3 Ft.
"D"	1029	3.7	30.74	
	1028	2.9	19.38	
	1027	1.5	36.90	
"C"	1025	3.0	42.72	
	1026	2.0	39.68	
	1030	3.4	39.10	
"B"	1024	2.4	48.75	
	1023	4.1	45.35	
	1032	1.5	24.34	
"A"	1021	3.6	41.75	
	1020	2.3	41.78	9.28
	1019	1.7	33.80	

DEPOSIT NO. 8

FIG. 21. ASSAY MAP, JUNEAU NO. 1 CLAIM

and 1 mile of medium-grade road would be required, which are estimated to cost $25,000 and $5,000, respectively. A request for access-road funds to build the tractor trail was not approved.

If the war program should be seriously dependent on chromite from this area, the program outlined may develop additional reserves of shipping ore. Most of the ore to be developed is expected to be milling grade. Construction of a mill would be necessary to produce a marketable concentrate. The program outlined would require the services of 25 to 30 men.

The areas proposed to be drilled are on high, bare ridges near the top of Red Mountain, where it is necessary to utilize water from melting snow for drilling purposes. This limits drilling to July and August, but erection of camps and construction of trails should be started early in June. The tentative plan of the proposed drilling is indicated in table 4.

TABLE 4. — Distribution of planned drilling

Deposit	Number of holes	Depth, feet	Total feet
8	1	110	110
8	3	55	165
9	3	100	300
11	2	65	130
11	1	130	130
11	1	160	160
11	2	80	160
2	1	300	300
2	1	200	200
	15		1,655

It is anticipated that the proposed drilling may develop 20,000 tons of shipping ore and 70,000 tons of milling ore.

Big Parade and Big Bend Claims

Attempts to hand-trench near the site of heavy chromite float on the Big Parade claim had to be abandoned at a depth of 9 feet. It was not definitely established that bed rock had been reached. The location is near the contact, and bed rock may be so highly brecciated that it is not distinguishable from the overburden.

Additional trenching by means of a bulldozer may reveal the chromite in place. Heavy float also has been found on the Big Bend claim south of the Chrome Queen claim.

Talus in Windy River Cirque

A huge talus slope has accumulated in Windy River cirque, at the base of Red Mountain, extending from the Chrome Queen claim almost to the head of Windy River. The material ranges in size from fine sand to huge boulders. A portion of this slope 2,000 feet long and adjacent to the Cliffside claim contains a high proportion of fine material that has been derived from a section of the cliff that appears to carry a larger amount of chromite than the normal dunite. There is some high-grade chromite float. The fine material contains a considerable quantity of free chromite grains, which evidently have been released by weathering of the olivine gangue. This portion of the slope will average 400 feet in width, and test pits along the base show it to be at least 8 feet in depth. Analyses of samples from the test pits are shown in figure 22.

Gravel in Windy River Valley

There are extensive unexplored deposits of gravel, composed principally of dunite from Red Mountain, in the Windy River, Seldovia River, and Fish Creek Valleys.

Test pits, panning tests, and analyses of samples are proposed to explore the gravel deposits of Windy River Valley. Metallurgical testing on a bulk sample of this material will be required to determine possible recovery and, if warranted, to develop a flow sheet for concentration. If results are sufficiently encouraging, the deposits may then be drilled to determine the tonnage and grade.

Specimen samples of the different rocks composing the intrusions, especially of the serpentine, should be analyzed to determine if nickel is present in commercial quantities.

Other Lode Deposits

Other lode deposits in the area are generally too small, too low-grade, or too inaccessible to warrant exploration under present conditions. The largest, deposits 12, 13, and 14, in the Fish Creek watershed, are long stringers up to 3.5 feet in width and containing low-grade chromite. Deposit 6 is a flatly dipping zone on the Cherokee Chief claim at an elevation of 2,300 feet. It consists of several short and discontinuous ore bodies containing some high-grade ore.

ORE RESERVES

The inferred ore reserves at deposits other than the Chrome Queen and Star No. 4 are shown in table 5.

TABLE 5. — Inferred ore at other deposits investigated

Deposit	Shipping ore, long tons	Concentrating ore, long tons	Cr_2O_3, percent
8	1,620	-	38.1
24	2,800	-	44.6
9	-	7,000	21.1
11	2,180	-	37.0
24	-	1,000	31.0
Totals	6,600	8,000	
Av., percent	40.5	22.3	30.5

A summary of all classes of reserves at deposits on Red Mountain that were investigated by the Bureau of Mines is given in table 6 as of January 1944.

TABLE 6. — Summary of ore reserves

Deposit	To be mined, long tons	To be milled, long tons	Sorted, long tons	Concentrates, long tons	Cr_2O_3, percent
Chrome Queen	2,786	-	2,786	-	42.9
Star No. 4 (No. 2)	111,174	-	47,130	-	41.7
Do.	-	44,044	-	-	19.1
Do.	-	-	-	15,000	45.0
Other deposits	14,600	-	6,600	-	40.5
Do.	-	8,000	-	-	22.3
Do.	-	-	-	3,100	45.0
Total	128,560	-	-	-	
Mill feed	-	52,055	-	-	19.6
Sorted ore	-	-	56,516	-	41.6
Concentrates	-	-	-	18,100	45.0

SAMPLING AND ANALYSIS

Six- by one-inch channel samples were cut at intervals along the outcrops, depending on the apparent continuity of the ore body and the amount of excavation required to expose it.

Drill cuttings were collected in a two-compartment sheet-metal collecting tank. Because of the banded high-grade nature of the ore, core recovery was stressed rather than cutting recovery. Holes of three sizes were drilled, but most of the ore was cored with EX (7/8-inch) bit. Core samples were taken as close as possible to show the grade of the individual bands. Both core and cutting samples were split, half being retained at the project until analyses were received. As the cutting samples were generally collected at 5-foot intervals, they can be used only as checks on the core analyses, and only core analyses have been used in calculating grade. Core recovery averaged 90 percent.

Six test pits were excavated in the talus slope in Windy River Valley. Every tenth shovelful was saved and quartered to make up the sample. All samples were analyzed at the Reno station of the Bureau of Mines.

Because of the heavy overburden and suspicion of faulting, drilling of deposit 23 (Chrome Queen) was planned to intersect the ore body at 50-foot intervals along the strike and at 35-foot intervals in depth. Owing to the persistence of deposit 2, drilling on Star No. 4 was planned to intersect the ore body at only 100-foot intervals in strike through the wider portion and at greater intervals to the north where the outcrop is narrower but still persistent.

Chromite in the Red Mountain area contains about 58 percent Cr_2O_3 and has a specific gravity of 4.4; that of dunite is 3.3. The specific gravity of 40-percent Cr_2O_3 ore is calculated to be 4.06, or 8.82 cubic feet to the long ton. The specific gravity of 20-percent ore is 3.68, or 9.74 cubic feet per long ton.

VALUE OF PRODUCT

The values of the different grades of shipping ore likely to be produced at Red Mountain have been calculated on the basis of the Metals Reserve Co.'s purchase schedule, dated May 15, 1943, for delivery at the wharf at Cook Inlet, and are listed in table 7.

TABLE 7. — Value of various grades of ore

Grade, percent	Cr to Fe ratio	Base price	Penalties and freight	Net value at tidewater, Cook Inlet
45	3:1	$52.80	$5.30	$47.50
44	2.9:1	52.80	7.90	44.90
40	2.7:1	52.80	15.30	37.50
35	2.4:1	52.80	25.30	27.50

ESTIMATED CAPITAL INVESTMENT TO DATE

Most of the equipment and material necessary for production is at the properties. Following is an approximate distribution of the costs to date.

Road	$500,000
Dock and ore-loading facilities	100,000
Housing	100,000
Mining equipment	35,000
Mine development	19,000
Tramway	125,000
Ore trucks and shop	21,000
	910,000

Source of the capital is understood to be as follows:

Access-road funds (Government)	$95,000
Chrome Queen Mining Co. (Reconstruction Finance Corporation loan)	50,000
Red Mountain Chromite, Inc. (private funds)	765,000
	910,000

Part of the road-building equipment, including one tractor, two trucks, a compressor, and all repair parts for the equipment furnished by the Government through the Alaska Road Commission, is included in this amount. The R. F. C. loan of $50,000 has been liquidated.

PROPOSED DEVELOPMENT SCHEMES

Three methods proposed for exploiting the Star No. 4 ore body, together with an estimate of the additional capital investment required, are discussed below.

1. Complete the tramway and build a camp on Red Mountain designed to withstand the severe winter climate at that elevation. Estimated cost of tramway, $40,000, and of camp, $70,000; total, $110,000.

2. Mine through an adit connected with the upper workings by a raise. In the absence of a detailed survey from Windy River to the apex of the ore body, Geological Survey maps were used in estimating that an adit having a maximum length of 2,000 feet and a raise of not over 1,200 feet would be required. Both of these distances may be shortened if it seems practical to start the adit at an elevation of about 1,500 feet, as seems probable. A truck road to the portal having a maximum grade of 10 percent would then be required. Estimated cost of tunneling and raising is $300,000.

3. Improve the existing tractor road up Red Mountain and mine the ore body from the present tunnel. The ore would be hauled by tractor wagons down the mountain to the truck road. Mine only during the summer, thus obviating the expense of a winter camp on the mountain. Estimated cost of road improvement, $30,000, and of summer camp, $30,000; total, $60,000.

ESTIMATES OF PRODUCTION AND COSTS, SORTED ORE ONLY

If the Star No. 4 deposit is exploited for shipping ore only, the upper part of the ore body will be mined. The southern part of the deposit will require resuing, which should yield a clean product. The northern part will necessitate sorting; but as the material to be discarded is principally only slightly enriched dunite, apparently none of it containing over 20 percent Cr_2O_3, it is believed that the required separation can be accomplished underground.

Open stopes or a cut-and-fill method would be best-suited to mining and sorting of this deposit. As the ore is high-grade, it should be mined with as few pillars as possible. However, it will be necessary to leave a 10-foot surface pillar over the deposit. This can be recovered at the close of the operation.

If consideration is given to shipping sorted ore only from the Star 4, it is estimated that 40,100 long tons of material would be broken, of which about 35,400 long tons would be ore containing 44 percent Cr_2O_3. Approximately 4,700 long tons of material containing less than 25 percent Cr_2O_3 would also be mined. Of this, the greater portion will be dunite removed in resuing and sorting. Losses in mining will reduce the total indicated shipping ore to 30,400 available long tons.

The Chrome Queen Mining Co. has an estimated reserve of approximately 2,800 long tons of ore. It will be possible to mine all the indicated ore in the Chrome Queen ore body during 1944. The other deposits are estimated to yield a total of 6,600 long tons of shipping ore.

Table 8 summarizes the shipping ore available at the deposit (No. 2).

TABLE 8

	Long tons	Cr_2O_3, percent
Material to be mined:		
Shipping ore mined clean	14,700	44.00
+38 percent ore remaining	20,700	44.00
-38 percent material, mostly dunite to waste dump	4,700	10.00
	40,100	
Shipping-ore losses:		
Wall losses	1,430	
Pillars, 5 percent	1,785	
Fines lost in stope, 5 percent	1,785	
10-foot roof pillar to be mined in later operation	-	
Total available shipping ore	30,400	44.00

A summary of all classes of reserves of direct shipping ore, as of January 1944, is shown in table 9.

TABLE 9

	Long tons	Cr_2O_3, percent
Chrome Queen	2,786	42.90
Star No. 4 (#2)	30,400	44.00
Other deposits	6,600	39.70
	39,786	43.27

MINING COSTS

Mining

It is estimated that Star No. 4 mining costs by open-stope or cut-and-fill methods, together with required development and sorting under the present Alaskan costs standards will be $9.60 per ton of ore mined.

TRUCKING AND LOADING AT KASITSNA BAY

Operating expenses and replacement of trucks every 18 months is estimated to cost $0.30 a long ton-mile, or approximately $3 a long ton from Red Mountain to the dock.

The cost of producing 1 long ton of hand-sorted shipping ore and delivering it to a local stock pile is shown in table 10. Mining cost per long ton, including cost of sorting, is $9.60.

TABLE 10

	Long tons	Cost
Mined:		
Chrome Queen	2,786	$26,745
Star No. 4	40,100	384,960
Other deposits	6,600	63,360
Total mined	49,486	475,065
Sorted ore to stock pile:		
Chrome Queen	2,786	
Star No. 4	30,400	
Other deposits	6,600	
	39,786	
Mining and sorting cost per ton	475,065 / 39,786 =	$11.95
Hauling per ton		3.00
		14.95

TABLE 10, Con.

Amortization (no interest included):	
Original capital	$910,000
Less liquidated R.F.C. Chrome Queen loan	50,000
Present capital	860,000
Additional capital:	
Method 1 (see page 41)	110,000
Method 2 (do.)	300,000
Method 3 (do.)	60,000
Total, method 1	970,000
method 2	1,160,000
method 3	920,000
Retirement cost per long ton sorted ore:	
Method 1	$24.38
Method 2	29.16
Method 3	23.12
Total cost per long ton of sorted ore:	
Method 1	39.33
Method 2	44.11
Method 3	*41.07

* Includes an additional $3 per ton for tractor haul of the mountain.

The weighted-average assay of the 39,786 tons is 43.3 percent Cr_2O_3, which at May 1943 Metals Reserve Co. prices at Cook Inlet has a value of $43.55 per ton.

BENEFICIATION TESTS ON CHROMITE ORE

Results of beneficiation tests conducted by the Bureau of Mines on a sample of similar ore from deposit 10, Claim Point,[7] indicate that the ore is amenable to concentration. A concentrate meeting Metals Reserve specifications for high-grade ore was produced from a feed containing 28.2 percent Cr_2O_3, 89 percent of the Cr_2O_3 content being recovered in a concentrate containing 45 percent Cr_2O_3 and 11 percent silica, with a chrome:iron ratio of 2.7:1. The method used to obtain these results was grinding the ore to minus 48-mesh, sizing hydraulically, and tabling. The middling and tailing were then ground to minus 200-mesh, sized, and retabled. The slime was recovered by settling and was mixed with part of the table middling and the table concentrate to yield the

7 Claim Point Chromite Deposit, Kenai Peninsula, Alaska: War Minerals Report 253, June 1943, 34 pp.

final product. Flotation tests were unsuccessful, as a more complicated procedure was required, and results were not as favorable as those obtained by tabling. It is evident that fine-grinding and sizing of the finely ground pulp are the principal milling problems. Suggested flow sheets for a crushing and hand-sorting plant and a flow sheet for a 100-ton mill are shown on figures 23 and 24.

Metallurgical tests conducted by the Bureau of Mines on a sample of talus material from Windy River cirque indicate that an excellent recovery of the Cr_2O_3 content is possible by grinding, classification, and tabling. Weathering has released a quantity of the chromite as free grains and has altered olivine gangue in the smaller fragments to a soft limonitic material, from which the chromite is released easily by grinding. From a feed containing 2.5 percent Cr_2O_3, 67 percent of the Cr_2O_3 was recovered in a concentrate containing 46 percent Cr_2O_3 and 19 percent iron. The chrome:iron ratio of 2.4:1 classifies the concentrate as "low-grade B" worth $27 a ton at local tidewater. A screen test of the material after it had been crushed to minus 3/4-inch for the head analyses indicates that 60 percent of the Cr_2O_3 is contained in material between 200- and 20-mesh, which represents 29 percent of the total material. These tests indicate a possible recovery of one unit per ton of mined material by milling 30 percent of the whole tonnage. A higher concentration of Cr_2O_3 in a much smaller percentage of material may be indicated by further screen tests.

From an average of 100 long tons per day of crude ore mined from the Star No. 4 deposit, it is estimated that 40 long tons of milling ore may be produced. If the milling ore is stock-piled, there should be 6,000 long tons in the stock pile after the first year's operation. The stock pile plus milling ore from continued operations will be enough to supply a 100-ton mill for 1½ years. In the meantime, the talus may prove to be workable, and other ore bodies may be developed to continue the mill supply for several

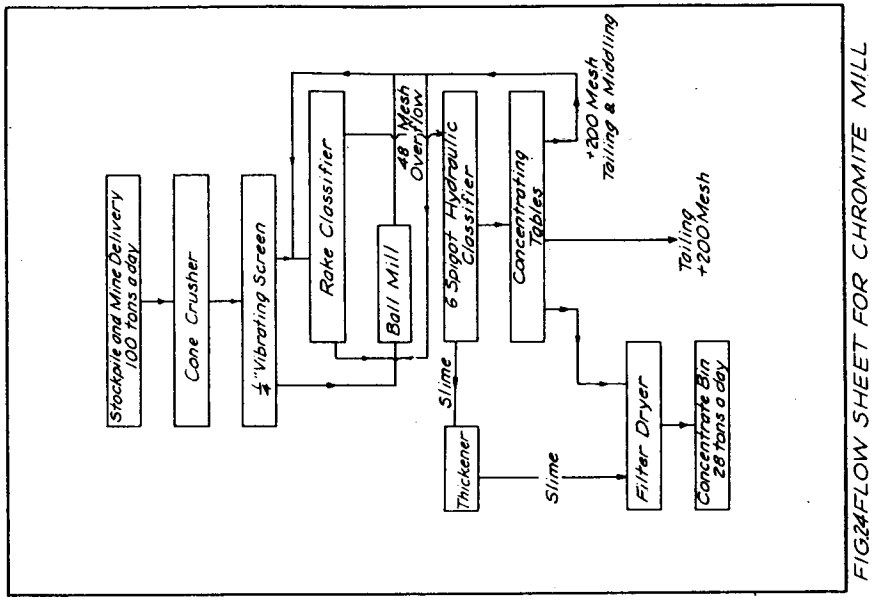


FIG. 24 FLOW SHEET FOR CHROMITE MILL

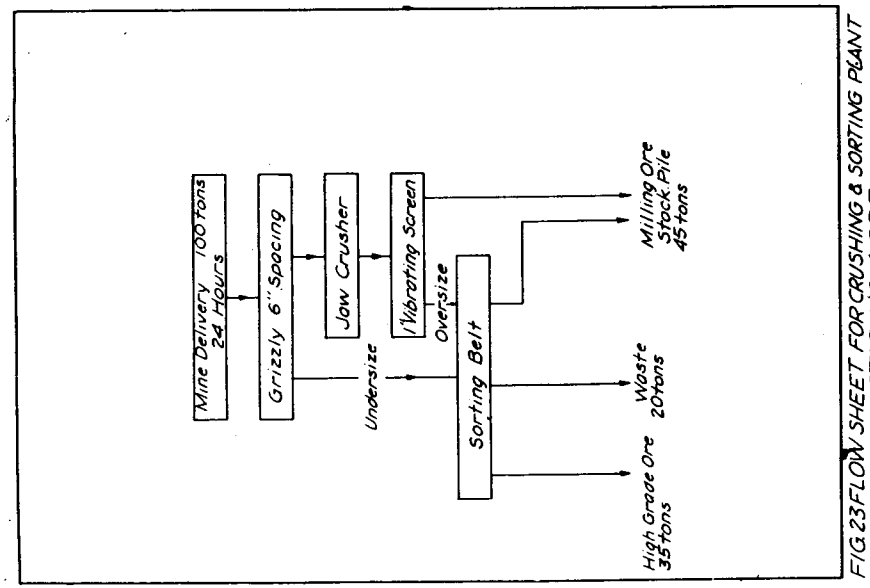


FIG. 23 FLOW SHEET FOR CRUSHING & SORTING PLANT STAR NO. 4 ORE

years more. At present, the need for a mill is based upon milling ore from the Star No. 4 deposit, which will be produced as a by-product in mining shipping ore. Mill construction could be delayed until the results of hand-sorting operations become apparent. Meanwhile, a sizable stock pile of milling ore will have accumulated.

A 100-ton gravity concentrating mill would be required to handle Star No. 4 and other low-grade ores during an indicated 4 years' operation. The over-all cost of installation would approximate $1,000 per ton of capacity under present machinery and labor prices.

Hand Sorting Mill Feed

It is indicated that 35 long tons of shipping ore will be sorted from 100 long tons of crude ore. Hand sorting by means of sorting tables is estimated to cost $2 per long ton of material recovered. If the ore is crushed and sorted from picking belts, the cost should be about half this amount.

MILLING COSTS

It is estimated that milling 44,044 long tons of 19.14 percent ore (see p. 29) that has been rejected by sorting in the Star 4 deposit will yield 15,000 long tons of 45-percent concentrate, assuming a recovery of 80 percent. From the other deposits, 8,000 long tons of 22.3-percent ore will yield 3,100 long tons of 45-percent concentrate. The estimated milling costs per long ton are shown in table 11.

TABLE 11

Operating costs per long ton of ore milled:	
Trucking to mill	$0.50
Hand-sorting	1.00
Milling	1.50
	3.00

	Mill feed, long tons	Concentrate, long tons
Ore milled:		
Star No. 4	44,044	15,000
Other deposits	8,000	3,100
	52,044	18,100

Mill cost to produce a long ton of concentrate:

$$\frac{52,044 \times 3.00}{18,100} = \$8.63$$

SUMMARY OF COSTS

Of 128,560 long tons of ore to be mined, 56,516 long tons of hand-sorted ore and 18,100 long tons of mill concentrate can be produced, making a total of 74,616 long tons of shipping ore and concentrates. The estimated total cost per long ton of shipping ore is shown in table 12.

TABLE 12. — Summary of costs

Cost of mining per long ton of ore		$9.60
Long tons mined:		
Chrome Queen	2,800	
Star No. 4	111,200	
Other deposits	14,600	
	128,600	
Production, long tons:		
Chrome Queen, sorted ore	2,786	
Star No. 4, sorted ore	47,130	
Other deposits, sorted	6,600	56,516
Star No. 4, mill concentrates	15,000	
Other deposits, mill concentrates	3,100	18,100
Total shipping ore and concentrates produced		74,616
Cost per long ton of hand-sorted shipping ore: $\frac{128,560 \times 9.60}{56,516}$ = $21.84		
Cost of hauling per long ton		3.00
Mining and hauling		24.84
Cost to mill a long ton of concentrates: $\frac{52,044 \times 3.00}{18,100}$ = $8.63		
(52,044 long tons crude ore to be milled, which will yield 18,100 tons of concentrates at a cost of $3 a ton of mill feed.)		
Cost of hauling a long ton of concentrates		3.00
Milling and hauling cost		11.63
Mining and sorting = 56,516 x 24.84 = $1,403,857		
Milling = $\frac{18,100 \times 11.63}{74,616}$ =		210,503
		1,614,360

Average cost per long ton of shipping ore and concentrates (amortization not included) = $\frac{1,614,360}{74,616}$ = $21.63

Amortization (interest not included):

Original capital	$860,000
Mill	100,000
	960,000

Method 1: $\frac{110,000}{\$1,070,000} \div 74,616 = \$14.34$

Method 2: $\frac{\$300,000}{\$1,260,000} \div 74,616 = \$16.89$

Method 3: $\frac{\$60,000}{\$1,020,000} \div 74,616 = \$13.67$

Summary:

Method 1:	
Mining and milling	$21.63
Amortization	14.34
	35.97
Method 2:	
Mining and milling	21.63
Amortization	16.89
	38.52
Method 3:	
Mining and milling	21.63
Amortization	13.67
	34.30

	Tons	Grade, percent
Sorted ore produced:		
Chrome Queen	2,786	42.9
Star No. 4	47,130	41.7
Other deposits	6,600	40.5
	56,516	41.6
Value per long ton		$40.64

	Tons	Grade, percent
Milling concentrates produced:		
Star No. 4	15,000	45.00
Other deposits	3,100	45.00
	18,100	45.00
Value per long ton of concentrate		$47.50

Method and Cost of Treating Talus

Although 67 percent of the Cr_2O_3 content of the total sample, or 1.7 units per ton, was recovered in the tests, economic recovery of chromite from this material will depend on discarding the bulk of the material at the mine as waste by sizing. Further screen tests should be run on uncrushed samples of the ore to determine the quantity of waste that can be eliminated at the pit. Available data indicate that 30 percent of the talus will have to be milled to assure recovery of one unit of Cr_2O_3 for each long

ton of original material. It is estimated that the talus can be mined and this 30 percent stock-piled at the mill for $0.25 per ton of original material. If this 30 percent can be milled for $1 a ton, a mining and milling cost of $0.58 per ton of original ore is indicated. As the iron content of the concentrate may be high enough to classify the product as "low-grade B," the concentrate would be worth only $27 per long ton or $0.60 per long-ton unit in the United States. This indicates a deficit in the operation. Further screen tests may show that enough low-grade material can be discarded at the pit to reduce materially the tonnage milled and possibly make the operation profitable. In addition to the fine chromite in the talus, there is an unknown quantity of high-grade and milling ore in pieces large enough to be picked from the waste belt. The talus material might prove to be an important source of mill feed, should a mill be built in the area.

Other Lode Deposits

The chief difficulty to be overcome in mining the other deposits is their inaccessibility. Deposit 24 may be reached by constructing half a mile of road from the Star No. 4 claim. A tramway to deposit 8 would be approximately 1 mile long and rise 1,200 feet, and might prove feasible because of its somewhat sheltered location. Deposit 11 is a quarter of a mile farther away and 500 feet above deposit 8 and would require extension of the tramway or road for access. Deposits 6 and 9 would be accessible by short roads from deposit 8. Because of higher access cost and smaller indicated quantities of ore in these deposits, cost of production from them will be greater than from the Star No. 4.

CONCLUSIONS

1. Results of Bureau of Mines exploration indicate the following available tonnages:

The Chrome Queen ore body contains approximately 1,800 long tons of ore averaging 42.9 percent Cr_2O_3 and an estimated 1,000 long tons of indicated ore containing 43.0 percent Cr_2O_3.

The Star No. 4 ore body is estimated to be capable of producing 47,130 long tons of shipping ore that will average 41.74 percent Cr_2O_3 and an additional 15,000 long tons of concentrate that will average 45 percent Cr_2O_3 if a mill is constructed. By mining 40,100 long tons from the upper part of the deposit without milling facilities, it is estimated that 30,400 long tons of 44-percent ore may be produced.

Other deposits. Ore indicated by trenching in deposits 8, 9, 11, and 24 totals 6,600 long tons that may average plus 40-percent Cr_2O_3.

2. A capital investment of $910,000 already has been made, of which the $50,000 Reconstruction Finance Corporation loan to the Chrome Queen Mining Co. has been repaid, leaving a net capital at present of $860,000. With an additional investment of $160,000 to $400,000, depending on the development method employed, about 56,500 long tons of 41.6-percent Cr_2O_3 sorted ore and 18,100 tons of 45-percent Cr_2O_3 concentrates could be produced.

3. To exploit the Star No. 4 deposit for shipping ore, it is estimated that $60,000 to $300,000 additional capital will be required, depending on the method of development employed.

4. Should war conditions make it desirable to increase further the production from these deposits, the drilling program proposed may indicate an additional 20,000 tons of shipping ore and 70,000 tons of milling ore.

oOo