UNITED STATES DEPARTMENT OF THE INTERIOR

BUREAU OF MINES

Region I - Alaska

EXAMINATION REPORT

TONSINA CHROMITE

Tonsina, Alaska

Alaska Mining Experiment Station
Juneau, Alaska
October, 1957

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TONSINA CHROMITE

Tonsina, Alaska

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SUMMARY

The 3 masses of ultrabasic rocks in the Tonsina area, known as Bernard Mountain, Dust Mountain, and Sheep Hill, are favorable prospecting areas for chromite. Outcrops and float indicate several specific localities worth further prospecting and evaluation.

Preliminary examination indicates low-grade ores requiring local concentration will comprise the bulk of potential reserves. Laboratory work on composites of examination samples suggests the chrome-bearing minerals vary from essentially chromite to picotite in composition. Higher-chromium Bernard Mountain ores should produce marketable concentrates containing over 48 percent Cr_2O_3 with a chrome to iron ratio about 2.7 to 1 and recoveries 80 percent or better. Dust Mountain lense-ores did not yield an acceptable concentrate in the preliminary testing.

Proximity to a surfaced highway, reasonable distance to the port at Valdez, and favorable topographic conditions should make the area attractive to the mining operator. The district presents a minimum of difficulties to the construction of access roads. Water is available for milling within reasonable distances and all-year operation might be possible if suitable reserves can be developed.

INTRODUCTION

A Bureau of Mines engineer[1/] examined the chromite exposures on

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1/ Pittman, T. L., Mining Engineer, Region I, Juneau, Alaska.

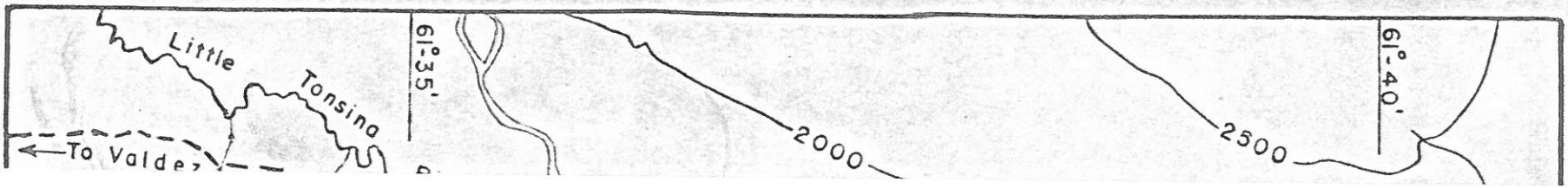
Bernard, Sheep and Dust Mountains southeast of Tonsina, Alaska in the southwestern Copper River basin area.

Speciman samples submitted to the Bureau of Mines in February, 1957 by the discoverers for petrographic examination directed the interest of the Bureau to the area as a possible chrome producer. This examination was made during the first week in August, 1957.

LOCATION AND ACCESSIBILITY

The areas examined lie about 75 miles northeast of Valdez, Alaska, and from 3 to 9 miles east of the Richardson Highway. This is shown on figure 1 and figure 2.

Bernard Mountain is a prominent bare, terracotta-colored peak rising to an elevation of 4845 feet. It is situated at 61° 34' 21" north latitude and 145° 08' 15"west longitude.


Little
Tonsina
To Valde
61°-35'
2000
2500
61°-40'

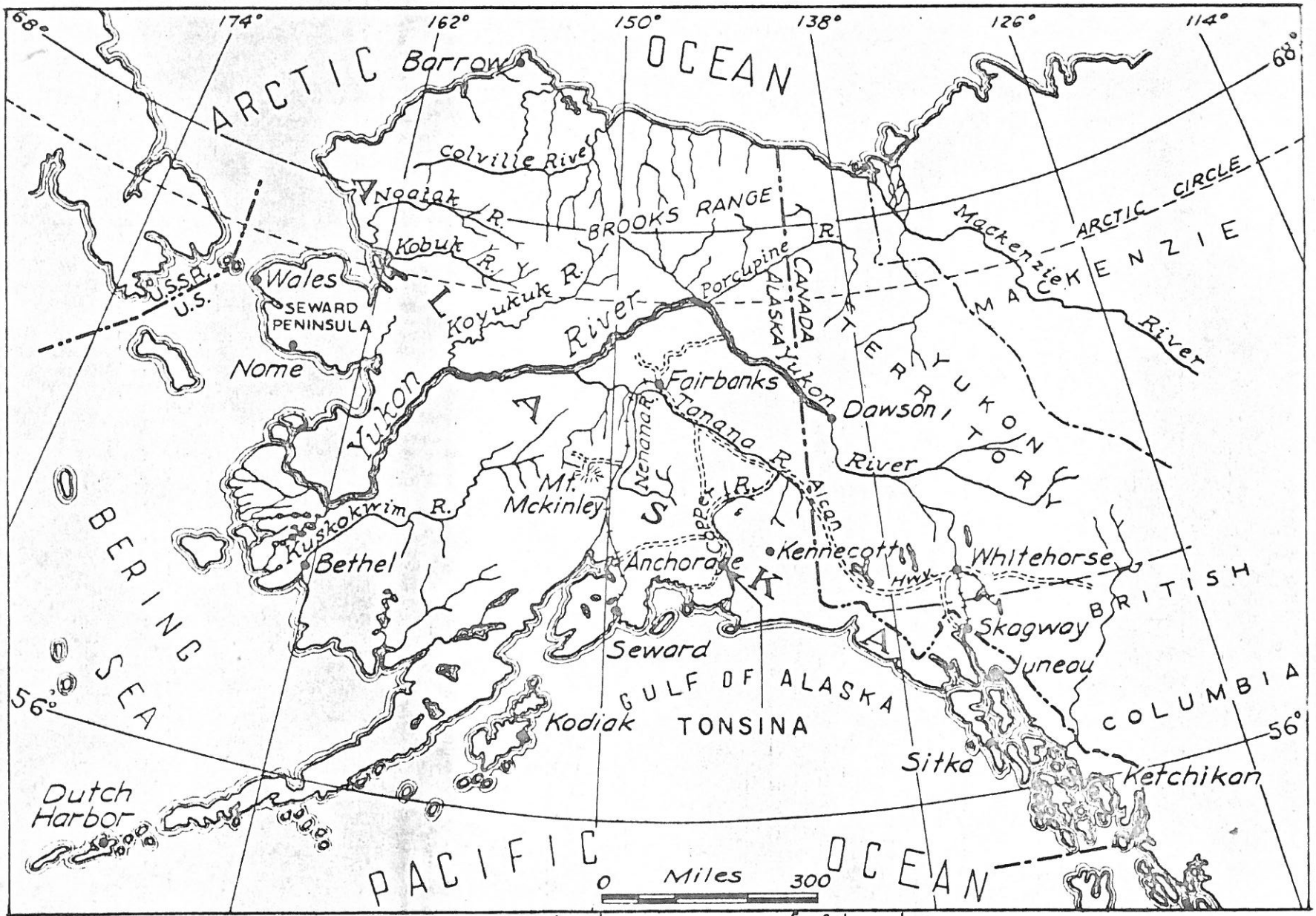


Figure 1.- Index map of Alaska.

The claim owners have bulldozed a rough cat-track from about mile 73½ north of Valdez and 6½ miles south of Tonsina on the Richardson Highway for a distance of 1.8 miles easterly up brush-covered gravel slopes toward the foot of the mountain. A pickup truck can travel this track, climbing from 1800 feet elevation at the highway to 2460 feet elevation. From there a track, at present impassable to trucks, continues about 1/2 mile up a steep gravel hillside to the foot of the talus-covered mountain slopes.

Road construction up to the foot of the mountain would be relatively easy. It is probable that a road could be built to the upper part of the mountain without too much difficulty by traversing the weathered, rubble-covered north slope. An access road could be built by a small bulldozer unit along the bench at approximately 3000 feet elevation to the chromite outcrops near the stream designated as Chrome Creek, about 1-3/4 miles northeast of the end of the present road.

Supplies and equipment would be shipped in through Valdez and trucked over surfaced highway to Mile 73½.

The Richardson Highway is the principal truck route from tidewater to interior Alaskan points. If properties in this area reach the production stage they might negotiate relatively favorable rates on crude ore or concentrates as back-haul van-lot truck freight to the port of Valdez and by ocean barge to west-coast United States ports.

A proposed hydro-electric development on the Copper River might greatly benefit any future mining operations in this district.

Timberline is at about 3000 feet elevation.

Springs flowing about 20 gallons of water per minute are located near the base of the west ridge of the mountain at about 3000 feet elevation. The flow in Chrome Creek was estimated at about 70 gallons per minute at the same elevation. Seasonal variations in flow are not known.

Sheep Hill and Dust Mountain are similar bare, reddish-brown mountains 5 miles and 7-1/4 miles airline, respectively, east-northeast of Bernard Mountain.

Sheep Hill is at 61° 35' north latitude and 144° 59' 30" west longitude. Dust Mountain is located at 61° 36' north latitude and 144° 56' west longitude. From Tonsina, at Mile 80½ on the Richardson Highway, it is possible to drive a pickup truck over old roads and 2½ miles of rough cat-track to a point some 3-3/4 miles to the east-south-east.

Present access is by foot or horseback approximately 7 miles and 10½ miles from the end of this cat-track. A crawler tractor or a swamp buggy could be used to move supplies and equipment to the bases of either of these mountains. This equipment could readily reach elevations of 3500 feet along Sheep Mountain and 3600 feet on Dust Mountain. Typical mountain slopes above these elevations are 30° to 35°, free of brush and timber, but mostly covered with coarse talus and finer rubble.

Bernard Mountain and Tonsina are shown on the Valdez (C-4) quadrangle 1 mile to 1 inch series topographic maps. Sheep Hill and Dust Mountain appear on the Valdez (C-3) quadrangle map.

The only useful flows of water observed in the Sheep and Dust Mountain areas were in the main streams shown on the topographic maps. None was observed on the mountain slopes.

HISTORY AND OWNERSHIP

Chromite was discovered about 3 years ago by Howard F. McWilliams and Harry G. Lund of Copper Center, Alaska, while prospecting ultrabasic rock masses for platinum. From the summit of Bernard Mountain 2 other bare, reddish-brown mountains were visible to the east. They later prospected the next one east, which they call Sheep Hill, and Dust Mountain, the far one. Chromite-bearing float was found on both and outcrops were located in 1956 on Dust Mountain.

A block of 55 lode claims was staked to cover Bernard Mountain while detailed prospecting was in progress. The owners indicated many of these had been dropped but at least 10 claims were being kept up, according to present plans.

Claims have been located on Sheep Hill covering an area of good float west-south-west of the peak.

At least 4 claims have been staked on the northwest slope of Dust Mountain covering the area of float and outcrops found to date.

None of these claims are patented.

MINERAL DEPOSITS

General Geology

The 3 mountains prospected appear to be masses of basic rock, tentatively classed as dunite, intruding grey volcanic and sedimentary rocks believed to be of Carboniferous age. Actual contacts are generally obscured by glacial gravel and clay or by rubble cover. Relative positions of these areas are shown on figure 2. Glacial cutting on the northwest side of Bernard Mountain and on most slopes of the other 2 mountains has been pronounced. It has resulted in some very steep, craggy slopes and the subsequent development of extensive talus areas covering large proportions of the surface.

On Bernard Mountain the resulting steep northwestern face apparently caved back at least 150 yards to the present summit and slid downward, resulting in a crescent-shaped subsidence bench with a maximum width of over 100 yards and a length of some 400 yards. The dunite in this settled area is badly crushed, jostled and displaced. Other similar, smaller areas are indicated. This feature is clearly visible on the aerial photographs of Bernard Mountain and is indicated on figure 3.

These crushed and displaced blocks complicate prospecting and will make development and mining of some of the mineralized zones virtually impossible.

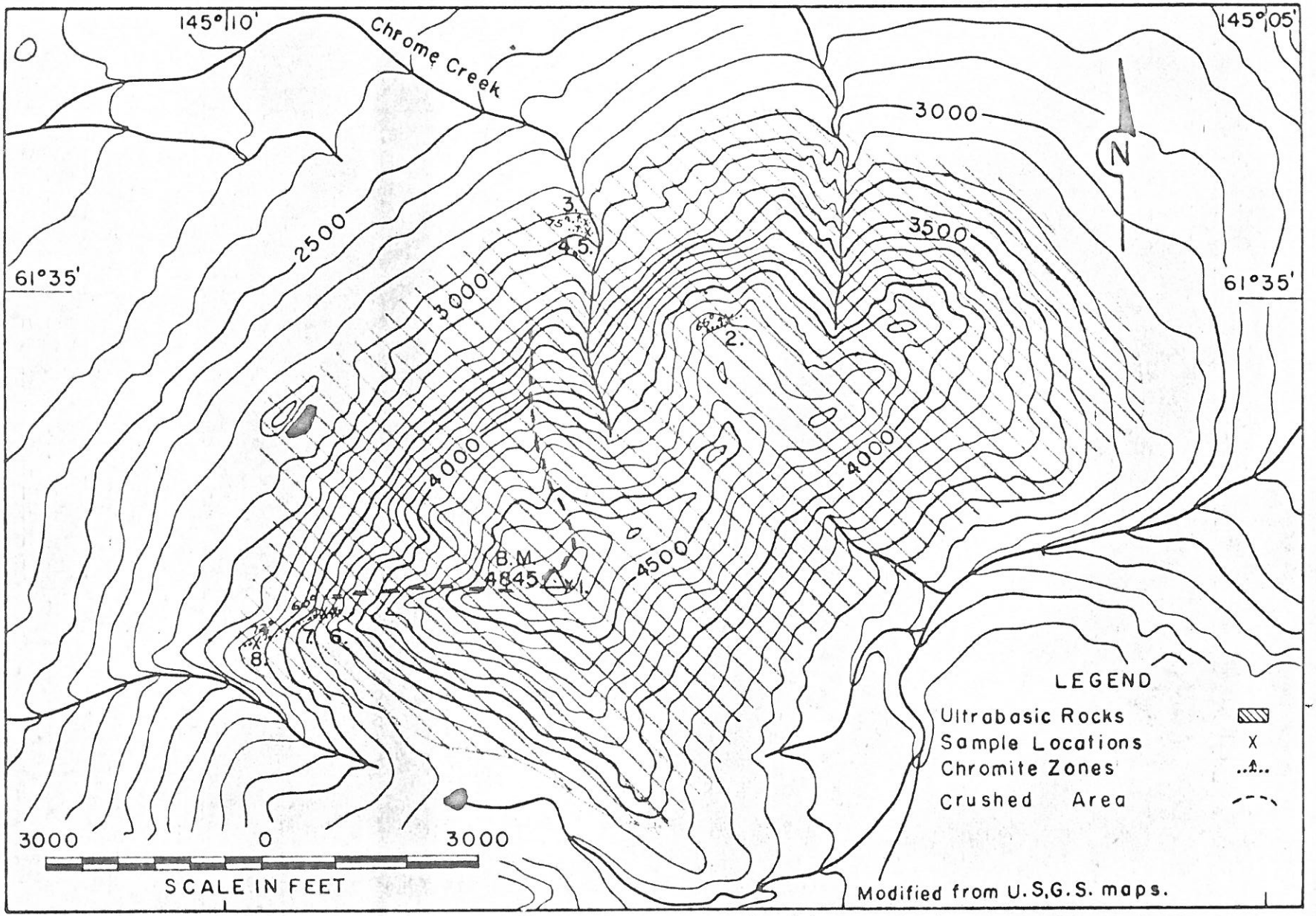


Figure 3.- Bernard Mountain.

TABLE 1. - Chemical analysis of samples

Sample	Location	Sample Length, ft.	Sample Analysis, - percent Cr_2O_3	Fe	SiO_2	Calc. Cr:Fe Ratio
1	Bernard Mt., summit float	grab	31.7	11.0	14.1	1.97
2	" " north ridge	6.0	11.3	8.8	31.1	0.88
3	" " Chrome Creek	0.9	22.4	8.1	25.0	1.89
4	" " " "	7.4	24.0	8.7	23.9	1.89
5	" " " "	6.9	26.2	9.0	22.7	1.99
6	" " upper S. ridge	3.6	5.32	9.8	36.2	0.37
7	" " " " "	3.6	6.59	10.4	34.2	0.43
8	" " lower S. ridge	3.8	12.5	10.3	31.9	0.83
9	Dust Mt., north trench	6.2	19.3	15.1	22.4	0.87
10	" " center trench	11.1	24.2	17.9	14.9	0.92
11	" " south trench	9.0	23.2	17.0	18.6	0.94
12	Sheep Hill, float	grab	28.5	12.7	18.8	1.54

TABLE 2. - Spectrographic analysis of sample 3

Cr	Fe	Si	Mg	Al	Co	Mn	Na	Ni	Ti	V	Ca	Mo	B	Cu	Ag	As	Au	Ba
A	A	A	A	B	D	D	D	D	D	D	E	E	F	F	--	--	--	--

Be	Bi	Cd	Ga	Ge	Hg	In	Li	Nb	P	Pb	Pd	Pt	Sb	Sn	Sr	Ta	Te	W
--	--	--	--	--	--	--	--	--	-	--	--	--	--	--	--	--	--	-

Zn	Zr
--	--

Legend:
A - more than 10 percent
B - 5 to 10 percent
C - 1 to 5 percent
D - 0.1 to 1 percent
E - 0.01 to 0.1 percent
F - 0.001 to 0.01 percent
G - less than 0.001 percent
-- - not detected

TABLE 3. - Petrographic analysis

Sample	Location	Analysis, percent Olivine	Antigorite	Pyroxene	Chromite
1	Bernard Mountain	70	29	--	1
2	Dust Mountain	96	2	--	2
3	Dust Mountain	4.5	10	85	0.5

Note: Index of refraction determinations indicate fayalite (Fe_2SiO_4) content of the olivine in sample No. 1 is approximately 7 percent and in sample No.2 is approximately 11 percent.

Good outcrops are scarce. Prominent jointing and fracture planes have helped produce a very concealing rubble cover on the normal mountain slopes.

Figure 2 shows the relative positions of the 3 dunite masses and the locations of the outcrops sampled.

Petrographic analysis of dunite from the summit of Bernard Mountain and of dunite and pyroxenite from northeast of trench 3 on Dust Mountain is shown in table 3.

Bernard Mountain

Bernard Mountain is a prominent reddish-brown mass of dunite roughly 1.3 miles wide and 2.2 miles long. The long axis is about N. 70° E. Figure 3 illustrates salient features on this mountain.

All of the chromite outcrops seen were adjacent to the crags of the northwest face of the mountain and in the walls of the gulch eroded through the glacier-cut bench at the foot of this slope by Chrome Creek. Several other outcrops, all containing very sparse mineralized banding, were described by H. F. McWilliams but were not visited.

Chromite-bearing banded float was present in several localities in the talus slides on the northwestern slope. Other areas were seen in the rubble on the southerly slopes.

High-grade mottled chromite float occurs at a distance of about 50 yards on a bearing of S. 50° E. from the summit bench mark. This float is plentiful in a rubble-covered area approximately 15 yards wide and 30 yards long. The long axis of this float area strikes about S. 55 ° E. No outcrops were visible and pits dug with a sample pick did not reach bedrock.

A grab sample of this area was taken on a 3-yard-square grid to determine the general character of the mineralization. This would be a very favorable location for trenching. Sample 1 from this area is listed in table 1. The Bernard Mountain petrographic sample in table 3 is from near the summit.

Another small area of high-grade mottled float was observed about 700 yards northeasterly from the summit in a small saddle at 4550 feet elevation. This was similar in character to the above but was not sampled. This float covered a visible area only about 5 yards in diameter. It should also be trenched or test-pitted.

Several zones of very sparse banded chromite mineralization were observed in the dunite along the ridge to the north.

About 1500 yards northeast of the summit monument, on a spur ridge between Chrome Creek and a small gulch draining into Bernard Creek, sample 2 was cut across a 6 foot banded chromite zone in dunite, exposed in the cliff northwest of the ridge and about 10 feet below it. This zone strikes S. 70° E. and dips about 70° northeasterly but the banding appears to strike about N. 60° E. and dip from 60° - 70° northerly. The zone is covered with rubble on the ridge and disappears under talus to the west and north. The outcrop consists of rather loose, badly fractured rock. Sixty feet or so northerly across a small gulch is a cliff showing badly fractured and serpentinized dunite with no visible chromite. The conditions suggest that a fault lies along the small gulch and the chromite zone sampled may actually be in a small subsidence block that is partially rotated.

North of the summit about 1600 yards, at approximately 3000 elevation, Chrome Creek has dissected the bench at the foot of the talus slopes, forming a steep-walled gulch about 50 feet deep. There is a small cascade, with a stream flowing an estimated 70 gallons per minute.

Sparse chromite banding was observed in limited outcrops for about 100 yards south of and above the falls. One band 2 feet wide runs into the north slope just above creek level, striking S. 70° E. and dipping 65° northerly. The chromite content of this band was estimated at about 5 percent. A probable fault, with serpentinization of the dunite crosses the gulch at a small angle and a northeasterly strike at the falls.

Sample 3 consists of 4 equally-spaced cuts across a zone 0.9 feet wide exposed on the west side of the gulch for a strike length of 17 feet on an outcrop about 50 feet west of the foot of the falls. This zone was well mineralized and had a pronounced yellow oxidation coating, suggesting possible vanadium content. This zone strikes about S. 80° E. and dips 75° to 80° northerly. The elevation is approximately 2910 feet. A spectrographic analysis of sample 3 is given in table 2.

A 7-foot zone of banded chromite lies 42 feet north of this small zone and parallel to it. This zone is exposed over its full width for a strike length of 9 feet. Sample 4 was cut at the east end of this exposure and sample 5 was cut 9 feet west at the other end of it.

Both of these zones can be traced up the west wall of the gulch to the overburden but with apparently decreasing chromite content. A strong system of joint and fracture planes in the dunite causes small block-fault offsets in these zones of up to about 2 feet. There is a series of north-south fractures of very steep dip, roughly paralleling the gulch, with displacements to the south as the observer moves westerly. There is also a system of east-west fractures dipping 20° south with displacements southerly in successively higher blocks.

These zones were not located in the fractured and serpentinized east wall of the gulch. They may be displaced and obscured in the altered, brecciated rock or may be limited in easterly strike by a structural feature lying along the gulch. Trenching or drilling on the east bench would be necessary to determining continuity or lack of it to the east.

The west ridge of Bernard Mountain contains low-grade chromite banding, with local serpentinized and fractured zones and some narrow high-pyroxene bands for some 2000 feet along a N. 80° E. strike, dipping 70° to 80° north. This zone is probably about 50 feet wide. The west end of the ridge, above the glacial cover, is a steep bluff of flat-lying conglomerate. It is an erosion remnant resting on dunite and containing dunite pebbles.

From this conglomerate to the summit the ridge is a steep, fairly uniform slope of dunite mostly covered with rubble but with a few outcrops. To the south it rounds off into a canyon that appears to lie along the south contact of the dunite mass. The north side of the ridge is cliffs and broken rock faces along the south edge of the glacial-cut cirque and its slumped area.

Sample 6 was cut on the edge of a cliff at an elevation of about 3750 feet over a width of 3.6 feet. It covers a concentration of chromite banding along the north edge of a very sparsely mineralized east-west zone about 50 feet wide. About 40 feet up-slope east of this sample a strong, steep, serpentinized and altered fracture system appears to terminate the chromite zone. Sample 7 is a 3.6 foot cut 8 feet west of Sample 6. The strike of the zone is N. 80° E. and the dip is 60° north.

At about 3330 feet elevation and 2000 feet east, sample 8 was cut on the same zone of mineralization as samples 6 and 7. This sample was cut over a 3.8 foot concentration of chromite on the north edge of a sparsely mineralized zone 43 feet wide, striking N. 80° E. and dipping 72° northerly. Assays of these samples are shown in table 1.

Dust Mountain

Dust Mountain is a mass of dunite and pyroxenite rock roughly 2 miles in diameter. The principal known outcrops of chromite are at an elevation of about 4100 feet on the northwest slope of the mountain in an area of bands of dunite and pyroxenite rocks, along the eastern edge of a predominantly dunite mass. This dunite extends from the glacial cover at about 3600 feet elevation up to about 4000 feet. Bands of pyroxenite appear in the dunite and up slope to the east the proportion of pyroxenite increases over the next 200 feet of vertical rise to a predominantly pyroxene rock with narrow bands of dunite, generally striking about S. 60° E. and appearing to dip 45° to 60° northerly.

Sparse chromite banding was observed in these rocks in various outcrops over a width of about 500 feet up the slope and 300 feet north and south of the trenched outcrops. Both banded and massive float is found for a distance of 500 yards northeasterly and 700 yards southwesterly from the main outcrop along a bearing of roughly N. 35° E. at the 4000 to 4200-foot elevation.

Other areas of low-grade banded chromite float have been observed on the mountain by H. F. McWilliams but were not visited on this examination. He had not found any other significant outcrops to date.

The outcrops sampled lie at about 4100 feet elevation, on the centerline of Dust No. 1 Lode Claim and about 850 to 950 feet from the north endline of the claim. The centerline of the claim bears N. 35° E.

Four small bodies of chromite, individually striking about S. 60° E. are arranged along a zone striking about N. 35° E. and are spaced from 20 to 30 feet apart. The individual bodies are from 3 to possibly 10 feet wide and from 6.2 feet to over 11.1 feet long. The 3 shallow trenches dug by the locator were each along the long axis of one of these small high-chromite masses. These masses appear to be fine-grained chromite with possibly some magnetite and silica in dunite. The bands of dunite and pyroxene rock between the masses appeared to be either devoid of visible chromite or had at most very sparse, localized, disseminated chromite banding and no significant percentage of chromite. Figure 4 illustrates this occurrence and shows the locations of samples 9, 10, and 11.

Apparent attitudes of these 4 small high-chromite masses and of the observed chromite banding throughout this area were all essentially the same, with strikes of from S. 65° E. to S. 55° E. and dips of from 47° to 72° northerly.

The average slope of the mountain is about -35° westerly and the trenches are at roughly the same elevation across the slope. They are in a rubble-obscured zone immediately below a belt of low cliff-like outcrops of predominantly pyroxene rocks containing bands and fingers of dunite. Observation of these rocks above the N. 35° E. zone and of small exposures of rock between the trenches, indicate that these chromite masses may be a ladder-work, with some minor displacements, within a narrow zone of deposition along a sutured dunite-pyroxenite contact, instead of faulted segments of one or more segregations each having a considerable strike length.

Samples 9, 10 and 11 were moiled from the 3 trenches indicated on figure 4 to obtain study samples on these high-chrome masses and do not in any way indicate the chrome content of the N. 35° E. zone of deposition. except as it may be indicated by the relative areas of these masses and the essentially barren intervening rock. Assay results are shown in table 1. Petrographic analyses of dunite and pyroxenite from this area ~~is~~ are shown in table 3.

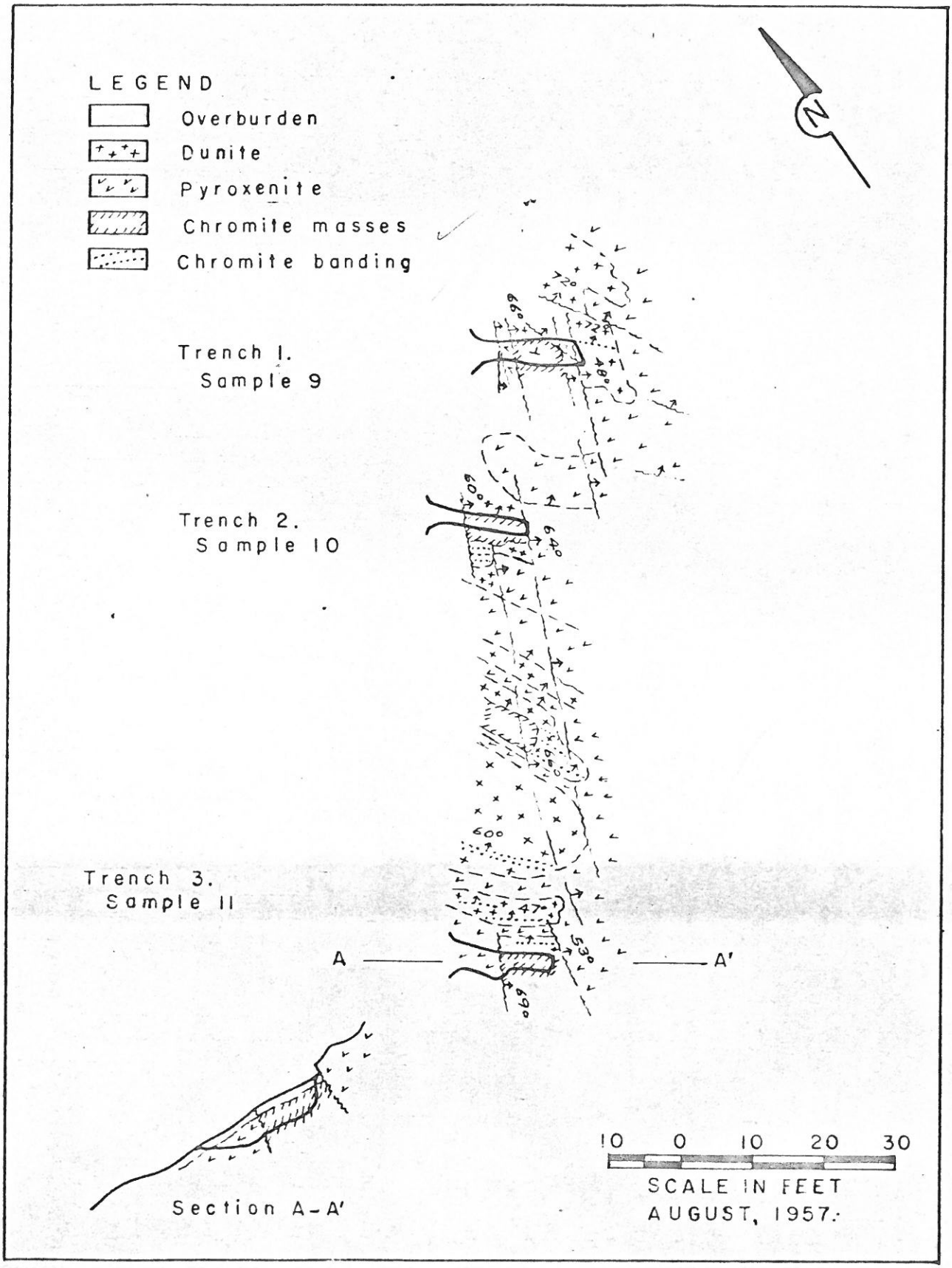


Figure 4.- Dust Mountain chromite outcrops.

Considerable additional trenching, surface-stripping and detailed geological mapping would be required to clarify the structural relationships. This work would be necessary before any drilling program could be planned. The nearest water available is in the small tributary of Dust Creek about 1/2 mile north and at an elevation of about 3400 feet.

Sheep Hill

Several occurrences of float have been observed on this smaller dunite mass by H. F. McWilliams but no definite outcrops have been located. Sample 12 is possibly from badly fractured bedrock in a shallow testpit located on the southwest corner of Sheep Hill at an elevation of about 4800 feet. This sample does not represent a proven outcrop and is usefull only to indicate the general character of the mineralization on this part of Sheep Hill. Location of this sample is shown on figure 2.

CONCENTRATION TESTS

Preliminary gravity concentration tests on composite samples prepared from the examination sample rejects indicate the chromium mineralization probably varies from spinels approaching chromite in composition to those of the picotite variety. Deposits in the Bernard Mountain dunite having the highest chrome content are most amenable to simple gravity concentration. Combined concentrates assaying more than 48 percent Cr_2O_3, with a chrome to iron ratio of about 2.7 to 1, and recovering 80 to 88 percent of contained chromium were made from the composite of Chrome Creek samples containing 23.7 percent Cr_2O_3 and 7.9 percent iron. The concentrate product, before combining with middlings, assayed 53.4 percent Cr_2O_3.

An intermediate grade composite carrying 11.3 percent Cr_2O_3 yielded concentrates assaying 52.4 percent Cr_2O_3 but the chrome to iron ratio was only 1.94 and the recovery 47 percent. The southwest ridge composite assaying 7.2 percent Cr_2O_3 recovered only 44.5 percent in a 39.1 percent Cr_2O_3 concentrate with a chrome to iron ratio of 1.23.

In each case the ore was stage-ground to pass a 65-mesh screen and tabled to produce concentrate, middlings and slime products.

The Dust Mountain lense-sample composite apparently contains minerals with a relatively low chromium content. Virtually all of the mineral was freed by grinding to pass a 35-mesh screen, compared to the 65-mesh grind required for Bernard Mountain ore. The best results obtained on 22.8 percent Cr_2O_3 feed by combined tabling and magnetic treatment of concentrates yielded a concentrate assaying 36.7 percent Cr_2O_3 with a chrome to iron ratio of 1.17 and a recovery of 67.7 percent.

The float sample from Sheep Hill yielded a combined concentrate assaying 47.9 percent Cr_2O_3 with a chrome to iron ratio of 1.99 and recovery of 73.8 percent. The concentrate alone assayed 51.2 percent Cr_2O_3.

Results of the most favorable tests on ores from each district are summarized in Table 4.

Composites of Chrome Creek samples and Dust Mountain samples assayed 0.26 and 0.23 percent nickel and less than 0.02-ounces per ton platinum respectively.

Complete details of the ore-testing work are given in the mineral dressing report "Preliminary Gravity Beneficiation of Tonsina Chromite Ore", by R. R. Wells, Bureau of Mines, Alaska Experiment Station, Juneau, Alaska.

CONCLUSIONS

Preliminary examination covered only a small portion of the total surface area of ultrabasic rocks, estimated to exceed 5.5 square miles. A small part of the Bernard Mountain dunite and a single locality each on Dust Mountain and Sheep Hill were investigated. Relatively shallow overburden formed by weathering of the jointed and fractured rocks masks most of the dunite surface. Talus covers considerable areas. The contacts of the dunites are generally at lower elevations, have flatter surface slopes, and are covered with thicker overburden or glacial debris. The deposit exposed by erosion of Chrome Creek gulch suggests the possibility of good mineralization fairly close to the contacts or outer rims of the dunites.

Mineralization in some of the observable outcrops indicates significant chrome deposits might be found by trenching and drilling.

Determination of the distribution, size and tenor of the deposits, their potential for the production of chromite and the occurrence and distribution of any accessory minerals associated with the ultrabasic rocks might add materially to the catalogue of strategic and economic reserves.

Jon L. Puttman,
Mining Engineer.

TABLE 4. - Preliminary concentration tests

Product	Weight, percent	Assay, percent Cr_2O_3	Assay, percent Fe	Assay, percent SiO_2	Distribution percent Cr_2O_3	Ratio Cr/Fe
Chrome Cr.:						
Concentrate	27.84	53.4	13.2	3.1	62.7	2.77
Middling	10.44	36.8	10.3	15.2	16.2	2.45
Tailing	32.32	5.2	4.4	37.2	7.1	
Slime	29.40	11.3	6.0	31.4	14.0	
Calc. head	100.00	23.7	7.9	23.7	100.0	
Comb. Conc. and Mid.	38.28	48.9	12.4	6.4	78.9	
Dust Mt.:						
Concentrate	43.68	36.7	21.4	3.8	67.7	1.17
Middling	12.94	24.1	16.7	15.6	13.2	
Tailing	26.13	8.1	10.0	30.3	8.9	
Slime	17.17	14.1	12.6	23.7	10.2	
Magnetite	.08	---	31.0	---	---	
Calc. head	100.00	23.7	16.3	15.7	100.0	
Sheep Hill:						
Concentrate	24.37	51.2	17.6	2.1	42.1	1.99
Middling	21.21	44.2	15.7	7.6	31.7	1.92
Tailing	25.87	10.0	7.5	33.2	8.7	
Slime	28.55	18.1	10.2	26.4	17.5	
Calc. head	100.00	29.6	12.5	18.3	100.0	
Comb. conc. and Mid.	45.58	47.9	16.7	4.7	73.8	