MI-052-01

TERRITORY OF ALASKA

DEPARTMENT OF MINES

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Sv. 1

Report on

Sinuk River
IRON ORE DEPOSITS
Seward Peninsula
Alaska

Owned by Chas. H. Esch 513 - 3rd Ave. Henry Seattle 4 Wn

A. B. Shallit
Assayer - Engineer

January 1942

TERRITORY OF ALASKA

DEPARTMENT OF MINES

ASSAY OFFICE

AT Page 1

January 27, 1942
Nome, Alaska

Mr. B. D. Stewart
Commissioner of Mines
Territorial Department of Mines
Juneau, Alaska

Dear Mr. Stewart:

Pursuant to your orders I have made an examination of the known iron deposits in the vicinity of Sinuk River and herewith present my report thereon.

The purpose of this examination was to investigate the possibilities of developing commercial iron ores, therefore the work was limited by these conditions.

Anticipating the possibility that others, less familure than yourself with the problem might desire to read this report, considerable extraneous material has been included.

Respectfully yours,

A. B. Shallit

A. B. Shallit
ENGINEER -ASSAYER

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PURPOSE OF REPORT

The present investigation has been brought about by the increased needs for iron by the defense industries, recently established in the Pacific Northwest because of the cheap hydroelectric power.

Iron deposits in the vicinity of Sinuk River on Seward Peninsula were known prior to 1900. Several United States Geological Survey parties have covered this district in their reconnaissance work but have not studied these deposits in sufficient detail to report on their commercial possibilities. In order to consider these commercial possibilities, a field examination was made between July 26th and September 20, 1941, and the report thereon is herewith submitted.

The purpose of this report is to summarize the findings of this examination and to make such recommendations as these findings warrant.

CONCLUSIONS

The results of this investigation indicate that the tonnage-and-grade of iron ore in the Sinuk River deposits is such that it can not be profitably exploited under present conditions. A more detailed investigation would probably reveal important additional tonnages but not in sufficient amounts to alter this conclusion.

The residual iron deposits may have resulted from the surficial enrichment of underlying lodes of some other metalliferous material; as such they warrant additional prospecting.

If the national emergency is such that iron ore is required on the Pacific Coast regardless of cost, important tonnages could probably be made available from these deposits. The nature of the ore-deposit is such that the cost of blocking out this ore would be relatively inexpensive.

RECOMMENDATIONS

Any further investigation of these deposits should be of an exploratory nature so that the genesis of the iron ore may be more fully revealed. When this is known it is believed that a better estimate of the probable depth of the deposit will be suggested and a workable approximation of the iron ore reserves made.

The physical conditions of the deposits are such that exploratory work could be carried on to the best advantage by the use of a bulldozer and a churn-drill.

It would be advisable that in the event the deposit is investigated for its iron content, exploration be carried far enough to determine the possible existence of other metalliferous material in depth.

INTRODUCTION

The purpose of this work was to investigate the possibility of developing commercial iron ore in the Sinuk River area. The U.S.G.S. have made some superficial investigations of these deposits but have not attempted to summarize their economic possibilities. Their reports have been freely drawn upon and are herewith acknowledged. The Survey have also reported on the general geology of the Seward Peninsula, and those parts of their reports pertaining to the geology of the Sinuk River area have been freely used.

FIELD WORK

The field work on which this report is based was begun July 26th and completed September 20, 1941. The U.S.G.S. had

already made a reconnaissance map on a scale of 1 ; 500,000 and 200 foot contour intervals, which included this Sinuk River area. Since topography was incidental to the ore-deposits in this study, this U.S.G.S. map was enlarged with a pantograph to 1:31,250 and contours were sketched in at 50 foot intervals. The detail map of the Monarch Group was made on a scale of 1 inch to 400 feet, and with a contour interval of 10 feet. This larger scale was used in order to approximate the ore reserves of this Group.

As much time as possible was spent on a study of the ore occurrences. The topographic mapping was completed as rapidly as possible and with only sufficient accuracy to insure the purpose of the study. Reconnaissance trips were made a distance of about fifteen miles from camp, but most of the work was confined to an area less than five miles in radius. Rain and fog prevailed through out the entire season making it difficult to map.

PUBLISHED REPORTS

The Publications of the U.S.G.S. that deal with the iron resources of the Sinuk River region are as follows:

Mineral Resources of Alaska, Report on Progress of Investigations in 1914, bulletin 622i, Iron Ore Deposits Near Nome, by H.M.Eakins pp 361-365.

Mineral Resources of Alaska, Report on Progress of Investigations in 1916, bulletin 662i, Lode Mining and Prospecting on Seward Peninsula, by J.B.Mertie Jr.,

LOCATION AND AREA

The area under consideration is situated in the southwestern part of Seward Peninsula, and about 25 miles northwest of the city of Nome. It has an area of over fifty square miles and includes eight known occurrences of iron mineralization. It is bounded on the north by the junction of Stewart and Sinuk Rivers and on the south by the junction of Sinuk River and Washington Creek; the Sinuk River flowing southward through the center of the region. The western limit is on the divide between Sinuk River and American Creek; the eastern limit is the divide between Cripple River and Washington Creek.

GEOGRAPHY

RELIEF

Most of the iron properties are found on the interstream ridges having elevations of between 700 and 1000 feet. These hills are probably the remains of a dissected, uplifted plateau, as shown by their accordant summit levels. These summit levels probably mark a peneplain, and other lower levels probably mark later periods of erosion. Besides the weathering action of sun, rain and frost, these uplands have been modified by the action of glaciers formed in the Kigluaik Mountains to the north.

The mountains north of this area are about 3000 feet in altitude. The peaks are jagged and the ridges sharp, and with steep sides. (14) Most of the valleys have their source in glacial cirques and are typically U sheped. Considerable morainal material has been laid down at the ends of these valleys, which together with the erosional action of the glaciers has modified the stream drainage.

Between the mountains to the north and the area under consideration lie the low lands of the Stewart River and American Creek. These may be accounted for by changes due to warping or by local glaciation.

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(14) Numbers in parenthesis refer to photographs in appendix.

Elsewhere in the area under consideration and that south of it, the hills are broad and rounded and the valleys are wide and with gently sloping sides.

DRAINAGE

The Sinuk River enters Bering Sea near Cape Rodney about 30 miles west of Nome. One of the largest rivers in the southern part of the Peninsula, it receives the drainage from the southern slope of the Kigluaik Mountains. The upper part of the river flows in a south-westernly direction for about fifteen miles, but just north of the iron area it is joined by the Stewart River and flows in a more southerly direction to the Bering Sea. The principal tributaries in the iron area are American Creek joining the Sinuk from the west and Washington Creek joining it from the east.

The Sinuk and most of its tributary streams have their sources in the mountains or high moss covered hills. The snow in the glaciers and the ice underlying the moss feed water to the streams throughout the open season so that there is usually considerable water in most of them. Washington Creek however, and some of the smaller creeks, are underlain by limestone and considerable stretches are often dry due to the water running underground. (8).

ECONOMIC FACTORS

There is no permanent settlement or even habitable cabins in the iron bearing area. A dilapidated shack on the Galena Lode, and one on the Monarch Group could if necessary be repaired. The nearest mining camp is that of the Oregon Creek Mining Company located on Oregon Creek, tributary from the east to Cripple River and employing less than five men. A prospector on Willow Creek, tributary to Cripple River and southwest of the area considered is the only other person living in this vicinity.

A practically abandoned eskimo settlement consisting of a few dilapidated shacks is situated at the mouth of the Sinuk River, about fifteen miles southwest of the iron area. This is variously known locally as Sinuk, Sinook, and Sinrock.

A temporary landing field was built on the Galena Lode property; about 16 bulldozer-hours would make this as good as the average local mining camp landing field.

Although it would be possible during high water to bring a shallow draft boat up the Sinuk River, the logical method of transportation aside from airplane, is by tractor and wagon. (11) Small volumes of freight could be brought in this way from Nome for about $50 per ton. Large amounts would probably be landed by boat at the mouth of the Sinuk and freighted by tractor and wagon to the area for considerably less.

GENERAL GEOLOGY

A description of the geology of the area under consideration has been included in various U.S.G.S. publications treating with the Seward Peninsula. Their findings have been incorporated in this more detailed study of the geology.

SCHISTS

No attempt has been made in mapping to differentiate the various kinds of schists found in this area. The most common kind is the chloritic schist which grades in color from a light green with little chlorite and considerable quartz and mica to the dark green rock consisting almost wholly of chlorite. Iron oxides derived from the weathering of iron bearing minerals have given the schists in the northern part of this area an outstanding brown colored outcrop.

The gray or greenish-gray feldspathic schists are the next most plentiful and are found in the central and western parts of this area. Albite is the most common feldspar and quartz and mica usually make up the rock. In places, as on American Creek this schist is heavily iron stained and has been staked as an iron ore.

Dark gray to black siliceous (graphitic ?) schist has been found on the ridge between Sinuk River and Washington Creek, south of the Galena Lode. This schist is composed almost wholly of quartz so that some specimens appear to be almost a quartzite. Locally this schist is apparently thin bedded and is underlain by chloritic schist and overlain by limestone.

LIMESTONE

Much of the area mapped as limestone is underlain by, and interbedded with, schists. Some of these schists are so calcareous that there is some doubt as to whether they should be classified as schistose limestone or calcareous schist.

The limestone varies in color from a white to a dark gray with most of it being light gray to a faintly bluish gray. It is all highly metamorphosed and so intensely folded and faulted that it is difficult to plot its structure. (6)

No satisfactory evidence has been found as to the age of this limestone, but it was believed by F.H.Moffit of the U.S.G.S. to be correlated with the Port Clarence limestone, and therefore of probable middle Paleozoic age. #

#U.S.G.S. bulletin 533, Nome and Grand Central Quadrangle, Page 31.

SEDIMENTARY ROCKS

Coal bearing series thought to be of late Mesozoic or Tertiary age # are found on Coal Creek a tributary to Sinuk River from the west and in the southern part of the mapped area. Because of the surface covering of tundra, it is difficult to define the area occupied by these sediments. However they do not appear to extend for more than a few hundred yards along the stream, and less than a mile at right angles to it. Other sedimentary material consists of a conglomerate, clay beds, and a fine grained altered extrusive (greenstone?).

Because the coal bearing formation is softer than the limestone and schist it is less likely to outcrop, so that the areal extent may be greater then indicated. It is unlikely that sufficient coal will be found to justify its use as a source of power for any local mining operation.

UNCONSOLIDATED DEPOSITS

The surficial deposits shown on the sketch maps consist of alluvial, elluvial and glacial material covered in places by tundra and vegetation. Some attempt has been made to map the underlying bedrock formation, but for the most part it is so effectively covered that the contacts cannot be drawn with any degree of accuracy.

The Gold Placers of Parts of Seward Peninsula, Alaska by A.H.Brooks and others. U.S.G.S. bulletin 328, page 85.

There is some water-lain material, but most of the accumulated rock is composed of angular debris resulting from subaerial weathering. It has been brought to its present position by gravity and by the pushing action of frost. Many glacial erratics overlay this material and in places it appears to be almost wholly morainal.

Large areas of glacial debris are found in the lower valleys of the Kigluiak Mountains. Some of these areas have covered most of the valley floor, and the present streams are cutting them away and mixing their materials with that of the bedrock errosion. By water and by ice action this material is brought down in the stream beds and deposited along the banks and shallow benches. (7) Glacial erratics are found in most of the high passes indicating ice action at that elevation. The residual rock masses on some of the higher hills indicate that there was no recent regional-glaciation. The Sinuk Valley may have been occupied by a glacier with tongues of ice spilling over the low passes, but the entire region was not submerged. (12) By damming and by other means this morainal material has altered the drainage pattern; the new streams often cutting deep canyons with reversed drainage as shown in the upper reaches of American Creek. (16)

ECONOMIC GEOLOGY

GOLD DEPOSITS

A sample of vein quartz from the Galena Group assayed 1.2 oz. silver and 0.02 oz. gold per ton. other samples from the iron stained limestone and from the iron ore itself failed to show important quantities of non ferrous minerals. The absence of commercial amounts of gold in the gossan indicates that there will be even less gold in depth. The deposit is such that leaching of the gangue material is a predominent factor with subsequent relative enrichment of gold in the leached zone. The absence of any amount of quartz float in the limestone and near the lime-schist contacts points to an absence of gold bearing quartz veins. The covering of tundra and of detrital material, in the vicinity of the intense mineralization to which the iron deposits are related, could serve effectively to hide gold quartz veins; these if found should be investigated.

Because the Sinuk River cuts the same type of schist and limestone that has been the source of the placer gold of the Nome area, it is possible that commercial gold placers may be developed. Colors of gold have been reported from many localities in this district. Considerable prospecting was done in the early days but no active mines are now in operation. The heavy mantle of residual and morainal material which has not been subjected to the sorting action of water lessens the liklehood of finding commercial placers.

COAL DEPOSITS IR 52-16

A description of the coal deposit on Coal Creek is taken from"The Gold Placers of Parts of Seward Peninsula, Alaska", by A. H. Brooks and others.#

"----a small area of unaltered sediments, including some coal beds, occur on Coal Creek----A tunnel driven into the west bank of Coal Creek across the strike of the coal-bearing strata exposed a number of thin seams of coal with beds of white fire clay between them. It is reported----that---seventeen stringers or thin seams of coal were exposed, the thickest of which measures about 16 inches, and the thinnest about 3 inches.---No analysis has been made, but the appearance of the coal indicates that it is bituminous and of fair quality.---it is evident that the deposit has little if any value on account of the small size of the beds.----it is not believed that the whole area of coal-bearing land is more than one-half of a square mile----."

WATER POWER

In reviewing the resources of this district the possibilities of water power should be considered. The northwest branch of American Creek, the outlet of Glacier Lake, the Sinuk River, and a spring (9) tributary to the left limit of Sinuk River between the Monarch Lode and the Galena Lode all offer possible water power sites. No water measurements of these have been taken, and it is entirely possible that a careful study of them would show that they could not be utilized. In Contemplating water versus diesel power, the period during which it could be kept in operation would have to be considered. Ordinarily this period would

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U.S.G.S. bulletin 328, pp.83-84

be limited by the water supply of the stream and by the climatic conditions.

The theoretical hydraulic horsepower of this region is probably in excess of any demands which might be put to it; but because of the high initial cost of installation and the short operating period it is improbable that water power plants could sucessfully compete with modern diesel installations.

ECONOMIC GEOLOGY

IRON DEPOSITS

The genesis of the iron deposits is obscured by the covering of detritus. Negative as well as affirmative evidence indicates that the ore has been deposited by near surface solutions circulating along lines of structural weakness in the limestone.

In the previously refered to U.S.G.S. bulletins, both Mertie and Eakin mention veins and stockworks of limonite. Although stockworks and replaced limestone were seen, the veins were inaccessable due to sluffing in the pits and were not observed during this examination. Assuming the existance of these veins the exposed iron ore is a residual concentration of the surficial material.

Limonite was observed deposited along such structural weaknesses as the crest of a possibly fissured anticlinal fold, tension cracks, and stockworks. Replacement and deposition was noted parrallel to and along the bedding plane of the limestone and along or near the contact between the limestone and the interbedded schists. Crackel-breccia and conglomerate were also found with limonite and calcite as the cementing materials. Besides the structural relations, the mineralogical association of pyrolusite and psilomelane with the limonite points to a deposit of secondary origin, as these manganese minerals are always secondary and formed under the influence of weathering. These deposits are all of near surface origin.

Although residual iron ore is sometimes derived from the decomposition of deposits of siderite by ascending waters, the finding of siderite in some of the residual material in these deposits does not preclude other methods of formation. Siderite is found in both epigenetic and syngenetic deposits, in fissure veins, as replacement in limestone and in sedimentary rocks as a product of the sedimentary processes.

There is a possibility that the iron ore is only the surface expression of underlying sulphide veins. The presence of galena on the Galena Lode and of sphalerite in the vicinity of

the Cub Bear Lode, as well as a few specimens which may be pseudomorphs after pyrite, and some cellular material is evidence of this possibility. The gossan of an ore high in iron sulphide is likely to be especially porous and to contain masses of iron stained quartz. Although the gossans in this area are fairly porous, a magiscopic examination fails to reveal any amount of quartz.

Iron ores have been formed by concentration by means of meteoric waters from lean iron formations. Such deposits are usually interbedded with normal clastic sediments, the limonite having been carried from considerable distances and redeposited by replacement of the limestone in relatively large quantities. Evidence against this source of mineralization here lies in the localization of the enriched portions of the various deposits, the absence of accessory minerals such as magnetite, the unfavorable climatic conditions, the absence of clay, and the general lack of evidence of normal sedimentation.

Because relatively little prospecting would be necessary to show the true genesis of the ore deposit it is impractical to theorize too much at this time. From the evidence on hand it appears that although many processes may have taken part in the formation of these deposits they are essentially surficial enrichments of underlying structural openings which had been filled by deposition from aqueous solutions.

MONARCH GROUP - KX 52-67

The Monarch group consists of 12 claims patented under Mineral Survey No. 503 and comprising about 240 acres. This deposit lies on the limestone ridge between Sinuk River and Washington Creek. The chief deposits of iron ore occur in gaps, one on the east side and one on the west side of the property.(4) Elsewhere the limestone is more or less iron stained but of too low a grade to be classed as an ore.

The entire mineralized area is mantled with residual material so that the ore was not seen in place. Numbereous shafts and pits were exposed to a maximum depth of four feet, but the bedrock was covered by sluff.

The observed ore consisted of residual limonite with some hematite and pyrolusite. In mapping this area an outline of the residual ore material was sketched and surface samples were taken in order to classify the different grades of ore. Since the underlying structure was not seen the mode of mineralization could only be inferred and the estimation of the probable tonnage limited to the observed surficial material.

The structural relationship was indicated by the stockwork of thin limonite veins exposed in the gully below the east ore body, by the observed cementing of crackle-breccea and by hand

specimens showing cementing of conglomerate and replacement along the bedding planes of the limestone. The topographic control is emphasized in the gully by the accumulation of high-grade residual limonite which may have had its source at a higher elevation.

A sample was taken from a 320 foot open cut on the east gap, (5) and also composite samples from various cuts and pits throughout the area. These were all of either surface material or material which had been thrown out on the surface. As no samples were obtained from the undisturbed veins the character of the ore in them was not determined.

Samples previously taken by the owners of the property show a higher iron content than those taken during this examination. This may be due to the difference in the material sampled, the place from which the sample was taken or possibly from leaching of the dumps during the twenty-five years between sampling. If the surface material has been considerably leached since the original sampling, the average grade of the ore will be higher and the probable tonnage increased in like proportion.

Although the area of the residual deposits is fairly well outlined the depth has not been shown. However an estimate has been made by assuming the average depth shown in the pits. The average assay value of the composite sample has been used.

About 50,000 long tons of ore are estimated available at 30 to 45% iron. About 500,000 tons are available averaging 15 to 25% iron. Considerable high grade limonite is seen as specimens on the surface; however ordinary mining methods would greatly dilute the grade of this ore and considerable reduction in tonnage by concentration would be necessary in making up a suitable smelter product of shipping grade.

GALENA GROUP - RX 52-70

The Galena Group consist of nine unpatented claims located about two miles southwest of the Monarch Group and on the same ridge, between Sinuk River and Washington Creek. Here, as on the Monarch, the surface is covered by residual material so that the ore was not seen in-place. The same general type of mineralization appears to have taken place? the residual concentration of sufficial weatheing of small limonite bearing stockworks and possible veins. In one pit limestone was exposed in which limonite was observed replaceing the limestone along the bedding planes and as vein filling in tension cracks. Some fine grained galena occurred along with the limonite.

At another exposure, along the west side of the property at or near a lime-schist contact, a calcite vein was observed containing irregular bunches of fine grained galena. A picked specimen assayed 1.99% iron, about 10% lead, 1.18 oz. silver and a trace of gold. Grab samples from three dumps near the

south end of the property showed 9.29%, 39.38%, and 16.17% iron and 0.025, nil and nil oz. of gold per ton with nil silver in all.

The average grade of the residual limonite is lower than that found on the Monarch and the areal distribution is much less. Present development work shows less than 100 tons of ore containing over 30% iron and about 10,000 tons of ore containing between 10 and 20% iron with the average content probably nearer the lower figure.

Mineralizing agencies here have affected a considerable area and prospecting in depth may reveal commercial bodies of nonferrous mineral. The present surface indications however, do not warrant exploration of this prospect with the expectation of developing commercial bodies of iron ore.

AMERICAN IRON LODE - KK 52-11

The American Iron Lode consists of four unpatented claims on the south slope of the valley of American Creek about two miles north and west of the Monarch Group. The same type of residual limonite occurs in an area about 300 by 1200 feet, if a larger area is covered by the iron ore it is obscured by a covering of vegitation. The occurrance of the iron at the base of a small limestone ridge and its relation to the schist is shown on the general sketch.

The iron here appears to be of a higher grade than that found on the Galena Group, and is similar to the higher grade material found on the Monarch Group. A surface grab from an 100' trench on the property assayed 37.81% iron, no gold or silver.

The development work consisted of a few pits which may orginally have been six to eight feet deep but at present are sluffed to within a few feet of the surface. An estimate of a possible 40,000 tons of 20 to 40% iron may be made for the residual material. Further prospecting may reveal that the extent of the mineralization has been magnefied by hillside creep, and that the ore in place occurs in a relatively narrow vein with a fairly steep dip, or as replacement along the bedding of the limestone. If so, the vein may show some depth, but the material on the down-hill side will be limited to a thin deposit of residual ore.

If commercial iron is ever developed in this district, the American Creek deposit will warrant further attention. No valuable non ferrous minerals other than manganese were found on this property. If prospecting in depth below the gossans of other deposits in this area should reveal commercial ore this prospect would also warrant exploration.

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CUB BEAR GROUP KX 52-72

The Cub Bear Group includes four unpatented claims along the limestone ridge between Washington Creek and Cripple River. The usual iron stained limestone and residual limonite were observed along the apparent outcrop of a vein. Mertie, in Mineral Resources of Alaska 1920, observed that the limonite occurred along the crest of an anticlinal fold in limestone (1) and suggested that the structural relations indicate that the ore had been deposited from aqueous solutions circulating along the fissured crest of the fold. To this observed structural relationship is added the probable zone of weakness along or close to the limestone-schist contacts. Some gravitational concentration has taken place in the gully below the saddle on which the limonite outcrops.

Outcrop along the limbs of the anticline show red and brown iron oxides parallel to and replaceing the limestone. (2,3). Samples across a seven foot width averaged 2.2% iron and a trace of gold.

Some fairly pure specimens of botryoidal and mammillary limonite were observed on the dumps of sluffed pits, but the average grade of the surficial iron stained material is less than that of most of the other prospects. A hundred tons of ore which might assay 30-45% iron and about 10,000 tons of 10-20% iron is all that can be approximated from the surface showings. It is doubtful that any commercial tonnages of high grade iron ore will be developed from this prospect.

MISCELLANEOUS IRON PROSPECTS

Residual concentrations of iron are found in several other localities in the immediate vicinity of the Monarch Group.

52-13 The Mogul property is situated on the ridge between Sinuk River and the head of Washington Creek. Any development work which might have been done has been sluffed in so that only the residual material was observed. Iron stained limestone appears in patches of a few yards in extent in several places along two low ridges. Only a few tons of low grade material is indicated from the surface exposures. Samples taken from the surface of the higher grade material assayed 9.60% and 12.41% iron. The usual highly metamorphosed condition of the limestone precluded the use of observations based upon structural evidence.

Some prospecting has been done on top of Tub Mountain (13) # 52-14 which is about three miles east and north of the Monarch Group, and near the junction of American Creek with the Sinuk River. Iron stained material appears over an area about 200 by 600 feet. A sample from the bottom of a two foot deep pit in this area assayed 15.38% iron. The limestone here was so highly altered that no structural determinations were made, although readings taken lower on the mountain indicated a limb of a fold.

A small highly mineralized area is found south east of the Monarch Group on the ridge between Washington Creek and Cripple River. Grabs, from an area 200 by 600 feet of high grade residual ore, assayed 44.27% iron. This grades into iron stained limestone on Iron Creek and appears again as several enriched areas on the hill slope boardering Cripple River. Exposures in the Iron Creek canyon show a series of iron stained limestone over 100 feet thick in which appear thin bands of yellow iron oxides; these bands replace the limestone along the bedding planes. A picked specimen of this replaced material assayed 12.69% iron, no gold or silver. If further iron exploration is attempted in this region, this locality will warrant further investigation. An estimated 12,000 tons of residual ore assaying about 30% iron is exposed on the surface.

Iron claims have been staked along the iron stained calcareous schists exposed on the banks of American Creek. Specimens of this schist assayed 2.31% iron. A few thin seams of quartz cut the schist but neither there nor near the limestone contacts was much mineralization noted. Nothing in this prospect indicates the possibility of developing commercial iron ore.

A fairly heavy concentration of residual limonite is found on the hill between Cripple River and Cleaveland Creek, east of

and just outside of the mapped area. This deposit appears to be in the limb of a fold similar to that found on Tub Mountain.

Elsewhere through the district boardering the Kigluaik Mountains are found iron stained areas similar to those already described. In several of these, heavily iron stained schists (16) as well as iron stained limestone were noted, but no areas were observed to be as heavily iron stained as the Monarch Group. Unless the latter proves of commercial worth, the others will probably not be worth considering as a possible source of iron ore.

ORE RESERVES

The following figures are not accurate measurements of the ore reserves of this district. They are approximations commensurate with the purpose of this report and are set forth only as indicative of what more detailed exploration might reveal. As depth factors of less than four feet were used for most of the estimates, the addition of only a few feet in depth would often double the following figures. In order to alter their present economic significance, however, these estimates would have to be increased by several hundred times.

RESIDUAL-ORE ESTIMATES

MONARCH GROUP

30 to 45 % iron.....	50,000	long tons.
15 to 25 % iron.....	500,000	" "

GALENA GROUP

30 to 45 % iron.....	100	" "
10 to 20 % iron.....	10,000	" "

AMERICAN IRON GROUP

20 to 40 % iron.....	40,000	" "

CUB BEAR GROUP

30 to 45 % iron.....	100	" "
10 to 20% iron.....	10,000	" "

MISCELLANEOUS

Mogul property

10 to 20 % iron.....	5,000	" "

Tub Mountain

10 to 20 % iron.....	8,000	" "

Iron Creek & vicinity

20 to 40 % iron.....	12,000	" "
10 to 20 % iron.....	20,000	" "

These estimates are for long tons of iron ore, not for tons of metallic iron.

TRANSPORTATION

Aside from the volume and grade of ore the outstanding factor governing the possible exploitation to these ore reserves is the cost of transporting the ore to the smelter. To the cost of moving the ore a distance of about 15 miles from the deposits to the beach is added the cost of placing the ore in the freighters and transporting it a distance of at least 2700 miles to Seattle. An additional charge is involved from the fact that the open season of navigation is only from the middle of June to the end of October.

Taking advantage of the river beds an ordinary trucking road could be built to the beach at a cost of $75,000 to $100,000. Maintenance costs on such a road would be high and over a long period railroad transportation might be cheaper.

The owners of the property claim ten fathoms of water close to the beach at the mouth of the Sinuk River and contemplate ore bunkers similar to those used on the Great Lakes. In 1938 an investigation by the Harbor Commission failed to find any such depth of water and suggested that freighting between shore and ship would have to be done, as at Nome, by lighter.

Even though some method of concentration were used to bring the quality of ore up to a shipping grade, a certain amount of gangue material would be included which would increase the relative cost of transportation and decrease the unit price paid

for the ore.

Unless millions of tons of shipping grade ore are blocked out it is doubtful that it can be landed at the smelter for less than its present market value.

SUMMARY

In summarizing the findings of this investigation, it must be borne in mind that the problem has been considered from a commercially practical view point rather than a long ranged contemplation of the possible future value of these deposits. A more detailed examination might subsequently alter these findings but it is doubtful if it could be done without benefit of actual exploration.

The genesis of the iron deposits have not been worked out in detail; but it is probable that the ore has been deposited by near surface solutions circulation along lines of structural weakness in the limestone. It is also possible that the iron is mearly a surface expression of an underlying sulphide lode. All of the exposed ore is of a residual nature so that no samples were obtained from the undisturbed material, nor was it possible to study the occurrance of the veins in place.

Several hundred tons of high grade limonite is scattered over the surface of the Monarch Group which is the most promising property. If the grade of the ore was brought to 30 to 45 % iron

about 50,000 tons of ore would be immediately available. About 500,000 tons of ore assaying about 15 to 25 % iron is also available on this property. Some increase in grade could be effected by concentration. Smaller amounts of similar grade ore are available at the other properties in this vicinity.

Some sulphide minerals were found but under conditions which did not justify predictions of primary metalliferous deposits in depth. Sufficient amounts of other valuable minerals were not found with the limonite to justify exploration for other than iron.

No estimates of the Probable Ore have been made as the limitations of the examination allow such varience in this figure that it would be of little value. A relativly inexpensive prospecting campaign could expose the possibilities of developing important tonnages of Probable Ore. With the exposure of the undisturbed veins a better understanding of the genesis of the ore would be possible and an estimate of the Possible Ore could be made.

Under more favorable geographic conditions this district would warrant thorough additional investigation of not only the sufficial deposits, but of the possible mineral resources in depth. The present examination has failed to reveal sufficiently important tonnages of iron ore to justify immediate exploitation.

Superficial sampling indicates that even tho large tonnages of ore might be made available in the future, they would require concentration.

The most detrimental factor to the exploitation or even exploration of these deposits is the cost of transporting the ore or concentrates from the mine to the smelter. With millions of tons of high grade iron ore easily minable, and with a large capital outlay, it is conceivable that even under the present economic and physical conditions iron ore might be mined and transported to the Pacific Coast at a profit. The results of this investigation however, do not warrant the expectation of such large tonnages of iron ore, and leave as the only commercial reason for further exploration, the possibility of finding metalliferous deposits in depth.

TERRITORY OF ALASKA

DEPARTMENT OF MINES

ASSAY OFFICE

AT_____

APPENDIX

ASSAY RESULTS

Samples taken by the writer were assayed at the Nome Assay Office of the Territorial Department of Mines. Aside from the assays shown in the body of this report, qualitative tests were made to confirm the results of analyses from other sources. The general agreement of these results precluded the necessity of detailed analysis. These were used in computing the tonnage and grade of ore at the various properties. Most of the samples were taken as surface grabs, and are admittedly valuable only as estimates indicative of surface values with little regard to depth. It is felt however that they do meet the requirements of this examination and as such are used as the basis for the conclusions found in this report.

Henry M. Eakin, in "Mineral Resources of Alaska, 1914 U.S.G.S. Bulletin 622" writes in reference to work done on the Monarch Group, "Two samples taken by the writer one from an open-cut at the east margin of the deposit and the other a composite sample from a line of open-cuts 400 feet long across its center were found to contain 53 and 55 per cent of metallic iron, respectively. The complete analysis of the composite sample, which is probably fairly representative of the whole deposit, is as follows:

SiO_2 5.53 Al_2O_3 1.34 Fe_2O_3 78.30 MgO 0.10 CaO 1.97

H_2O 10.40 CO 1.10 TiO none P_2O_5 0.13 S trace MnO 1.37

BaO trace Total 100.24%. The iron, manganese, phosphorus, and sulphur contents of the ore calculated from this analysis, are as follows; Fe 54.81, Mn 1.06, P 0.057, S trace."

A sample submitted by Charles Esch, one of the owners of the Monarch Group, to Lewis and Walker, Assayers and Chemists, at Los Angeles, was assayed January 7, 1941 with the following results: Iron, 30.90%, Silica, 3.14%, Phosphorus, 0.13%, Manganese, 0.37%.

Quoting from a report written by the above mentioned Charles Esch, dated June 1938:

"The following will show the results of tests made on the ore:

	Iron ore #1	Ore # 2	Ore # 3	Ore #4	Ore #5	Ore #6
Silica	2.14	8.64	3.85	4.82	0.90	2.70
Iron	58.76	53.92	59.86	57.55	37.19	15.29
Manganese	0;44	0.74	0.38	0.75	0.90	11.22
Phosphorus	.026	0.022	0.010	0.015	0.004	0.17

Description	Iron	Phos.	Mangan.	Silica	Lime
# 1	53.88	0.047	0.83	7.07	---
# 2	45.34	0.049	0.89	4.15	---
# 3	34.76	0.038	0.92	1.00	23.0 "

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SKETCH MAPS

SINUK RIVER IRON ORE DEPOSITS

As mentioned in the body of this report, under the heading "Field Work", this sketch is based on a U.S.G.S. reconnaissance map. In changing the scale from 1:500,000 and 200 foot interval to 1:31,250 and 50 foot interval a few minor topographic details were altered to fit in with the new scale; in general however, the original topography was accurate. The smaller interval allowed for more structural details to be shown and formed a basis for plotting the geology in some detail. Some points were plotted by plane table and alidade; so much foggy weather was encountered thatthe work was completed using an aneroid and by more sketching than the scale of the map warranted.

The entire geology of the region was included in the U.S.G.S. map under undifferentiated metamorphic rocks. This sketch differentiates thelimestone from the schists and indicates the position and relative size of the iron bearing areas. Under surficial deposits are included morainal, alluvial and elluvial material.

A Short and Mason mining dip needle was used in testing for the occurrance of magnetic iron. Tests were made over most of the outcrops but without positive results. This was in accord with the visual examination which failed to reveal any strongly magnetic minerals.

MONARCH GROUP IRON DEPOSITS

Control points for this sketch were claim corners of Mineral Survey 503. Plane table, alidade and stadia were originally used, but so much foggy weather was encountered that this sketch was also completed by aneroid and paceing. The ten foot contour interval indicates a greater accuracy than sketching by aneroid and paceing allows, but considering the original control points and stadia work, it was felt that the work was sufficiently accurate for the purpose for which it was intended, and that a larger interval would fail to show the topography in sufficient detail. An original elevation was assumed by approximation from the 200 foot interval U.S.G.S. map.

The geologic contacts are of course only as accurate as the topography. The plotting of the schist-limestone-surficial contacts were handicapped by the covering of vegitable matter. As in the Sinuk River Iron Ore Deposits sketch, the continuation of the bedrock formations under the surficial material could often be infered, but the approximate boundaries of the surficial material was plotted as it actually appeared. In both sketches, small deposits of interbedded schists may occur in the limestone but due to the residual nature of the material were of a necessity plotted as limestone. For the most part these schists were of a calcareous nature.

The iron ore was all of a residual nature so that accurate plotting would involve a greater degree of sampling than the survey warranted. It was possible, however, to approximate the grade by the color, and this basis was used in establishing the boundaries of the different grades as shown on this sketch. As no definate cut-off line could be drawn, these boundaries were only approximate. The tonnage estimates were based upon the depth as well as the areal extent of the deposits, and as the depths used varied with the approximate depths shown in various pits, the boundaries of the grades of ore shown on the sketch are sufficiently accurate.

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SINUK RIVER IRON ORE DEPOSITS, Photographs

CUB BEAR, showing
east limb of anticline

No. 1

CUB BEAR, showing limonite replacement and filling along bedding planes of limestone. West limb of anticline.

No. 2

No. 3

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SINUK RIVER IRON ORE DEPOSITS. ... aphs

NO. 4

Monarch Lodes from north side of Sinuk River. East and west gaps.

NO. 5

Monarch Group, east gap saddle

NO. 6.

Highly metamorphosed limestone near Monarch Group.

Parasite Photographs

Sinuk River, granite boulders from Kigluaik Mountains.

No. 7

No. 8

Dry creek-bed of Washington Creek, granite glacial erratics on lime-stone bedrock.

Cold-spring, left limit Sinuk River below Monarch Group Iron Lodes.

No. 9

No. 10

Base camp, Sinuk River iron survey.

No. 11

Freighting by tractor and rubber-tired trailer.

No. 12

"Stone House", a schist errosional monument on ridge between Penny and Cripple River.

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SINUK RIVER IRON ORE DEPOSITS, Photographs,

Kigluaik Mountains in background, Sinuk River left foreground, Tub Mountain right foreground.

No. 13

Looking north-east toward Kigluaik Mountains from Monarch Lode.

No. 14

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SINUK RIVER IRON ORE DEPOSITS, Photographs.

In the Kigluaik Mountains.

No. 15

Canyon near head of American Creek caused by Kigluaik Mountain moraine damming original drainage.

No. 16

Condensation of Report on

Simuk River
IRON ORE DEPOSITS
Seward Peninsula
Alaska

A. B. Shallit
Assayer - Engineer

January 1942

CONCLUSIONS

The results of this investigation indicate that the tonnage-and-grade of iron ore in the Sinuk River deposits is such that it can not be profitably exploited under present conditions. A more detailed investigation would probably reveal important additional tonnages but not in sufficient amounts to alter this conclusion.

The residual iron deposits may have resulted from the surficial enrichment of underlying lodes of some other metalliferous material; as such they warrant additional prospecting.

RECOMMENDATIONS

Any further investigation of these deposits should be of an exploratory nature so that the genesis of the iron ore may be more fully revealed. When this is known it is believed that a better estimate of the probable depth of the deposit will be suggested and a workable approximation of the iron ore reserves made.

The physical conditions of the deposits are such that exploratory work could be carried on to the best advantage by the use of a bulldozer and a churn-drill.

It would be advisable that in the event the deposit is investigated for its iron content, exploration be carried far enough to determine the possible existence of other metalliferous material in depth.

INTRODUCTION

LOCATION AND AREA

The area under consideration is situated in the southwestern part of Seward Peninsula, and about 25 miles northwest of the city of Nome. It has an area of over fifty square miles and includes eight known occurrences of iron mineralization. It is bounded on the north by the junction of Stewart and Sinuk Rivers and on the south by the junction of Sinuk River and Washington Creek; the Sinuk River flowing southward through the center of the region. The western limit is on the divide between Sinuk River and American Creek; the eastern limit is the divide between Cripple River and Washington Creek.

GEOGRAPHY

RELIEF

Most of the iron properties are found on the interstream ridges having elevations of between 700 and 1000 feet. These hills are probably the remains of a dissected, uplifted plateau, as shown by their accordant summit levels. These summit levels probably mark a peneplain, and other lower levels probably mark later periods of erosion. Besides the weathering action of sun, rain and frost, these uplands have been modified by the action of glaciers formed in the Kigluaik Mountains to the north.

ECONOMIC FACTORS

A temporary landing field was built on the Galena Lode property; about 10 bulldozer-hours would make this as good as the average local mining camp landing field.

Although it would be possible during high water to bring a shallow draft boat up the Sinuk River, the logical method of transportation aside from airplane, is by tractor and wagon. (11) Small volumes of freight could be brought in this way from Nome for about $50 per ton. Large amounts would probably be landed by boat at the mouth of the Simuk and freighted by tractor and wagon to the area for considerably less.

ECONOMIC GEOLOGY

IRON DEPOSITS

The genesis of the iron deposits is obscured by the covering of detritus. Negative as well as affirmative evidence indicates that the ore has been deposited by near surface solutions circulating along lines of structural weakness in the limestone.

In the previously referred to U.S.G.S. bulletins, both Mertie and Eakin mention veins and stockworks of limonite. Although stockworks and replaced limestone were seen, the veins were inaccessable due to sluffing in the pits and were not observed during this examination. Assuming the existance of these veins the exposed iron ore is a residual concentration of the surficial material.

Limonite was observed deposited along such structural weaknesses as the crest of a possibly fissured anticlinal fold, tension cracks, and stock works. Replacement and deposition was noted parrallel to and along the bedding plane of the limestone and along or near the contact between the limestone and the interbedded schists. Crackle-breccia and conglomerate were also found with

limonite and calcite as the cementing materials. Besides the structural relations, the mineralogical association of pyrolusite and psilomelane with the limonite points to a deposit of secondary origin, as these manganese minerals are always secondary and formed under the influence of weathering. These deposits are all of near surface origin.

Although residual iron ore is sometimes derived from the decomposition of deposits of siderite by ascending waters, the finding of siderite in some of the residual material in these deposits does not preclude other methods of formation. Siderite is found in both epigenetic and syngenetic deposits, in fissure veins, as replacement in limestone and in sedimentary rocks as a product of the sedimentary processes.

There is a possibility that the iron ore is only the surface expression of underlying sulphide veins. The presence of galena on the Galena Lode and of sphalerite in the vicinity of the Cub/Bear Lode, as well as a few specimens which may be pseudomorphs after pyrite, and some cellular material is evidence of this possibility. The gossan of an ore high in iron sulphide is likely to be especially porous and to contain masses of iron stained quartz. Although the gossans in this area are fairly porous, a megascopic examination fails to reveal any amount of quartz.

Iron ores have been formed by concentration by means of meteoric waters from lean iron formations. Such deposits are usually interbedded with normal clastic sediments, the limonite having been carried from considerable distances and redeposited by replacement of the limestone in relatively large quantities.

Evidence against this source of mineralization here lies in the localization of the enriched portions of the various deposits, the absence of accessory minerals such as magnetite, the unfavorable climatic conditions, the absence of clay, and the general lack of evidence of normal sedimentation.

Because relatively little prospecting would be necessary to show the true genesis of the ore deposit it is impractical to theorize too much at this time. From the evidence on hand it appears that although many processes may have taken part in the formation of these deposits they are essentially surficial enrichments of underlying structural openings which had been filled by deposition from aqueous solutions.

MONARCH GROUP

The Monarch group consists of 12 claims patented under Mineral Survey No. 503 and comprising about 240 acres. This deposit lies on the limestone ridge between Sinuk River and Washington Creek. The chief deposits of iron ore occur in gaps, one on the east side and one on the west side of the property. Elsewhere the limestone is more or less iron stained but of too low grade to be classed as an ore.

The entire mineralized area is mantled with residual material so that the ore was not seen in place. Numereous shafts and pits were exposed to a maximum depth of four feet, but the bedrock was covered by sluff.

The observed ore consisted of residual limonite with some hematite and pyrolusite. In mapping this area an outline of the

residual ore material was sketched and surface samples were taken in order to classify the different grades of ore. Since the underlying structure was not seen the mode of mineralization could only be inferred and the estimation of the probable tonnage limited to the observed surficial material.

The structural relationship was indicated by the stockwork of thin limonite veins exposed in the gully below the east ore body, by the observed cementing of crackle-breccia and by hand specimens showing cementing of congolomerate and replacement along the bedding planes of the limestone. The topographic control is emphasized in the gully by the accumulation of high-grade residual limonite which may have had its source at a higher elevation.

A sample was taken from a 320 foot open cut on the east gap, and also composite samples from various cuts and pits throughout the area. These were all of either surface material or material which had been thrown out on the surface. As no samples were obtained from the undisturbed veins the character of the ore in them was not determined.

Samples previously taken by the owners of the property show a higher iron content than those taken during this examination. This may be due to the difference in the material sampled, the place from which the sample was taken or possibly from leaching of the dumps during the twenty-five years between sampling. If the surface material has been considerably leached since the original sampling, the average grade of the ore will be higher and the probable tonnage increased in like proportion.

Although the area of the residual deposits is fairly well

outlined the depth has not been shown. However an estimate has been made by assuming the average depth shown in the pits. The average assay value of the composite sample has been used.

About 50,000 long tons of ore are estimated available at 30 to 45% iron. About 500,000 tons are available averaging 15 to 25% iron. Considerable high grade limonite is seen as specimens on the surface; however ordinary mining methods would greatly dilute the grade of this ore and considerable reduction in tonnage by concentration would be necessary in making up a suitable smelter product of shipping grade.

GALENA GROUP

The Galena Group consist of nine unpatented claims located about two miles southwest of the Monarch Group and on the same ridge, between Sinuk River and Washington Creek. Here, as on the Monarch, the surface is covered by residual material so that the ore was not seen in-place. The same general type of mineralization appears to have taken place, the residual concentration of surficial weathering of small limonite bearing stockworks and possible veins. In one pit limestone was exposed in which limonite was observed replacing the limestone along the bedding planes and as vein filling in tension cracks. Some fine grained galena occurred along with the limonite.

At another exposure, along the west side of the property at or near a lime-schist contact, a calcite vein was observed containing irregular bunches of fine grained galena. A picked specimen assayed 1.99% iron, about 10% lead, 1.18 oz. silver and a trace of gold. Grab samples from three dumps near the

south end of the property showed 9.29%, 39.38%, and 16.17% iron and 0.025, nil and nil oz. of gold per ton with nil silver in all.

The average grade of the residual limonite is lower than that found on the Monarch and the areal distribution is much less. Present development work shows less than 100 tons of ore containing over 30% iron and about 10,000 tons of ore containing between 10 and 20% iron with the average content probably nearer the lower figure.

Mineralizing agencies here have affected a considerable area and prospecting in depth may reveal commercial bodies of nonferrous mineral. The present surface indications however, do not warrant exploration of this prospect with the expectation of developing commercial bodies of iron ore.

AMERICAN IRON LODE

The American Iron Lode consists of four unpatented claims on the south slope of the valley of American Creek about two miles north and west of the Monarch Group. The same type of residual limonite occurs in an area about 300 by 1200 feet, if a larger area is covered by the iron ore it is obscured by a covering of vegitation. The occurrance of the iron at the base of a small limestone ridge and its relation to the schist is shown on the general sketch.

The iron here appears to be of a higher grade than that found on the Galena Group, and is similar to the higher grade material found on the Monarch Group. A surface grab from an 100' trench on the property assayed 37.81% iron, no gold or silver.

The development work consisted of a few pits which may orginally have been six to eight feet deep but at present are sluffed

to within a few feet of the surface. An estimate of a possible 40,000 tons of 20 to 40% iron may be made for the residual material. Further prospecting may reveal that the extent of the mineralization has been magnefied by hillside creep, and that the ore in place occurs in a relatively narrow vein with a fairly steep dip, or as replacement along the bedding of the limestone. If so, the vein may show some depth, but the material on the down-hill side will be limited to a thin deposit of residual ore.

If commercial iron is ever developed in this district, the American Creek deposit will warrant further attention. No valuable non ferrous minerals other than manganese were found on this property. If prospecting in depth below the gossans of other deposits in this area should reveal commercial ore this propsect would also warrant exploration.

CUB BEAR GROUP

The Cub Bear Group includes four unpatented claims along the limestone ridge between Washington Creek and Cripple River. The usual iron stained limestone and residual limonite were observed along the apparent outcrop of a vein. Mertie, in Mineral Resources of Alaska, 1920, observed that the limonite occurred along the crest of an anticlinal fold in limestone and suggested that the structural relations indicate that the ore had been deposited from aqueous solutions circulating along the fissured crest of the fold. To this observed structural relationship is added the probable zone of weakness along or close to the limestone-schist contacts. Some gravitational concentration has taken place in the gully below the saddle on which the limonite outcrops.

Outcrop along the limbs of the anticline show red and brown iron oxides parallel to and replacing the limestone. Samples across a seven foot width averaged 2.2% iron and a trace of gold.

Some fairly pure specimens of botryoidal and mammillary limonite were observed on the dumps of sluffed pits, but the average grade of the surficial iron stained material is less than that of most of the other prospects. A hundred tons of ore which might assay 30-45% iron and about 10,000 tons of 10-20% iron is all that can be approximated from the surface showings. It is doubtful that any commercial tonnages of high grade iron ore will be developed from this prospect.

MISCELLANEOUS IRON PROSPECTS

Residual concentrations of iron are found in several other localities in the immediate vicinity of the Monarch Group.

The Mogul property is situated on the ridge between Sinuk River and the head of Washington Creek. Any development work which might have been done has been sluffed in so that only the residual material was observed. Iron stained limestone appears in patches of a few yards in extent in several places along two low ridges. Only a few tons of low grade material is indicated from the surface exposures. Samples taken from the surface of the higher grade material assayed 9.60% and 12.41% iron. The usual highly metamorphosed condition of the limestone precluded the use of observations based upon structural evidence.

Some prospecting has been done on top of Tub Mountain which is about three miles east and north of the Monarch Group, and near the junction of American Creek with the Sinuk River.

Iron stained material appears over an area about 200 by 600 feet. A sample from the bottom of a two foot deep pit in this area assayed 15.38% iron. The limestone here was so highly altered that no structural determinations were made, although readings taken lower on the mountain indicated a limb of a fold.

A small highly mineralized area is found south east of the Monarch Group on the ridge between Washington Creek and Cripple River. Grabs, from an area 200 by 600 feet of high grade residual ore, assayed 44.27% iron. This grades into iron stained limestone on Iron Creek and appears again as several enriched areas on the hill slope boardering Cripple River. Exposures in the Iron Creek canyon show a series of iron stained limestone over 100 feet thick in which appear thin bands of yellow iron oxides; these bands replace the limestone along the bedding planes. A picked specimen of this replaced material assayed 12.69% iron, no gold or silver. If further iron exploration is attempted in this region, this locality will warrant further investigation. An estimated 12,000 tons of residual ore assaying about 30% iron is exposed on the surface.

Iron claims have been staked along the iron stained calcareous schists exposed on the banks of American Creek. Specimens of this schist assayed 2.31% iron. A few thin seams of quartz cut the schist but neither there nor near the limestone contacts was much mineralization noted. Nothing in this prospect indicates the possibility of developing commercial iron ore.

A fairly heavy concentration of residual limonite is found on the hill between Cripple River and Cleaveland Creek, east of

and just outside of the mapped area. This deposit appears to be in the limb of a fold similar to that found on Tub Mountain.

Elsewhere through the district boardering the Kigluaik Mountains are found iron stained areas similar to those already described. In several of these, heavily iron stained schists as well as iron stained limestone were noted, but no areas were observed to be as heavily iron stained as the Monarch Group. Unless the latter proves of commercial worth, the others will probably not be worth considering as a possible source of iron ore.

ORE RESERVES

The following figures are not accurate measurements of the ore reserves of this district. They are approximations commensurate with the purpose of this report and are set forth only as indicative of what more detailed exploration might reveal. As depth factors of less than four feet were used for most of the estimates, the addition of only a few feet in depth would often double the following figures. In order to alter their present economic significance, however, these estimates would have to be increased by several hundred times.

RESIDUAL-ORE ESTIMATES

MONARCH GROUP		
30 to 45 % iron.....	50,000	long tons.
15 to 25 % iron.....	500,000	" "
GALENA GROUP		
30 to 45 % iron.....	100	" "
10 to 20 % iron.....	10,000	" "
AMERICAN IRON GROUP		
20 to 40 % iron.....	40,000	" "
CUB BEAR GROUP		
30 to 45 % iron.....	100	" "
10 to 20 % iron.....	10,000	" "
MISCELLANEOUS		
Mogul property		
10 to 20 % iron.....	5,000	" "
Tub Mountain		
10 to 20 % iron.....	8,000	" "
Iron Creek & Vicinity		
20 to 40 % iron.....	12,000	" "
10 to 20 % iron.....	20,000	" "

These estimates are for long tons of iron ore, not for tons of metallic iron.

SKETCH MAPS

SINUK RIVER IRON ORE DEPOSITS

As mentioned in the body of this report, under the heading "Field Work", this sketch is based on a U.S.G.S. reconnaissance map. In changing the scale from 1:500,00 and 200 foot interval to 1:31,250 and 50 foot interval a few minor topographic details were altered to fit in with the new scale; in general however, the original topography was accurate. The smaller interval allowed for more structural details to be shown and formed a basis for plotting the geology in some detail. Some points were plotted by plane table and alidade; so much foggy weather was encountered that the work was completed using an aneroid and by more sketching than the scale of the map warranted.

The entire geology of the region was included in the U.S.G.S. map under undifferentiated metamorphic rocks. This sketch differentiates the limestone from the schists and indicates the position and relative size of the iron bearing areas. Under surficial deposits are included morainal, alluvial and elluvial material.

A Short and Mason mining dip needle was used in testing for the occurrance of magnetic iron. Tests were made over most of the outcrops but without positive results. This was in accord with the visual examination which failed to reveal any strongly magnetic minerals.

MONARCH GROUP IRON DEPOSITS

Control points for this sketch were claim corners of Mineral Survey 503. Plane table, alidade and stadia were originally used, but so much foggy weather was encountered that this sketch was also completed by aneroid and pacing. The ten foot contour interval indicates a greater

accuracy than sketching by aneroid and pacing allows, but considering the original control points and stadia work, it was felt that the work was sufficiently accurate for the purpose for which it was intended, and that a larger interval would fail to show the topography in sufficient detail. An original elevation was assumed by approximation from the 200 foot interval U.S.G.S. map.

The geologic contacts are of course only as accurate as the topography. The plotting of the schist-limestone-surficial contacts was handicapped by the covering of vegetable matter. As in the Sinuk River Iron Ore Deposits sketch, the continuation of the bedrock formations under the surficial material could often be inferred, but the approximate boundaries of the surficial material were plotted as they actually appeared. In both sketches, small deposits of interbedded schists may occur in the limestone but due to the residual nature of the material were of a necessity plotted as limestone. For the most part these schists were of a calcareous nature.

The iron ore was all of a residual nature so that accurate plotting would involve a greater degree of sampling than the survey warranted. It was possible, however, to approximate the grade by the color, and this basis was used in establishing the boundaries of the different grades as shown on this sketch. As no definite cut-off line could be drawn, these boundaries were only approximate. The tonnage estimates were based upon the depth as well as the areal extent of the deposits, and as the depths used varied with the approximate depths shown in various pits, the boundaries of the grades of ore shown on the sketch are sufficiently accurate.