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State of Alaska
Department of Natural Resources
DIVISION OF MINES AND MINERALS
P. O. Box 1391
Juneau, Alaska 99801

TECTONICS AND ORE DEPOSITS IN ALASKA*

by Gordon Herreid, Mining Geologist
State Division of Mines and Minerals

INTRODUCTION

My purpose here today is to analyze the regional geologic patterns of Alaska and attempt to relate ore districts to some of the major features of the geology. In order to do this it is convenient to consider the geology from a tectonic point of view, tectonics being the study of the large scale uplift and subsidence of the earth's crust and the movements along major crusted fractures.

The geologic map of Alaska shows a rather orderly arrangement of arcuate metamorphic-igneous belts flanked by late Mesozoic sediments and Cenozoic basins, all expressions of the tectonic frame work. These arcuate belts are followed or cut at small angles by major arcuate fractures or lineaments which in some areas appear to control the location of igneous intrusive and extrusive rocks and ore deposits. I intend to discuss first the development of these regional geologic features, and then, a possible relationship of ore districts with them.

The whole of Alaska lies within a mobile belt that extends along the Pacific fringe of the North and South American continents. For most of its length this belt is the transition zone between the Pacific Ocean basin and the continental platforms and along it the crust has been more mobile than in either the ocean areas or on the continent. In recent years it has been shown, particularly by a number of Russian authors, that there is a rather definite succession of events in the history of the mobile belts in different regions. The following resumé of the development of an idealized mobile belt through one cycle of deformation consisting of 3 phases is taken largely from the Russian literature.

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A cycle of deformation begins with the early geosynclinal phase, starting with an increase of crustal mobility over a large region. During this period there takes place subsidence and uplift of elongated geosynclines and geanticlines which are somewhat like waves on the sea. The areas of subsidence predominate and may be up to several tens of miles wide. Deep fracturing of the crust, often in the more mobile areas, results in lava flows and sheet intrusions of basic magma. Topographic relief is moderate with siltstone the principal sediment deposited, often interbedded with basic volcanic rocks. Little folding takes place at this time. Toward the end of this phase the relief becomes even less and limestone may be widespread due to lack of clastic sediments. In Central Alaska this early geosynclinal phase probably began in the Middle Devonian and continued to the end of the Triassic.

The late geosynclinal phase is marked by a general predominance of uplift over subsidence with orogeny taking place in those geosynclines with the thickest early phase deposits. This orogeny is termed inversion by Beloussov and is characteristically accompanied by folding, metamorphism, granite intrusion, and uplift over large areas in the geosyncline. These uplifted early geosynclines in the mobile belt have been referred to as central uplifts. They are compensated by subsidence in marginal troughs which may begin as marine troughs and end as intermontane troughs as the uplift of the entire region progresses. If the inversion of the geosynclines is well developed, these marginal troughs may finally overlie the margins of the original geosyncline giving a complete reversal of the topographic features. Inversion may not be carried to completion, however, particularly along the continental margin, in which case granite intrusion, metamorphism, and uplift are not so well developed. During inversion, large wedges of clastic material eroded from the rising land area are deposited in the marginal troughs. Much of Alaska is underlain by Mesozoic clastic wedges of this type flanking areas of older rock. In Alaska the late geosynclinal phase persisted from the Jurassic until early Tertiary time.

The young platform phase begins when block faulting takes the place of folding as the principal means of deformation. This consolidation of the folded belts may take place at different times in different places when block uplifts and basins are superimposed on the earlier folded structures. Deep fractures formed at this time are responsible for narrow belts of igneous intrusions and extrusions. This is a continental period which, in Alaska, has lasted from the early Tertiary to the present.

The geosynclinal evolution that has been described applies to the area on the oceanward side of the mobile belt. This is the true or eugeosyncline. Near the platform geosynclinal subsidence is slower and is unaccompanied by volcanism so that limestone, sandstone, and shale are the normal sediments, and the inversion is not usually accompanied by granite intrusion or metamorphism. This is the miogeosyncline, which represents a gradation between the platform and the eugeosynclines.

In general, during both early and late phases of geosynclinal development, rapid warping of the crust leads to the formation of deep fractures which give rise to igneous activity. After consolidation, in the young platform stage, igneous activity accompanies deep fracturing without warping, often with block movements.

GEOSYNCLINAL DEVELOPMENT

In Alaska fossiliferous early Paleozoic rocks crop out sporadically in and around the central uplifts as far south as the Alaska Range. These rocks are largely limey and shaley sediments without volcanics and, with some exceptions, are typical of miogeosynclinal sediments deposited along the relatively stable continental margin. Beginning in Devonian time this shelf became more mobile, and in the Goodnews Arch, Post-Devonian rocks changed from limestone to mainly impure clastic rocks and volcanics. On the northern flank of the Yukon-Tanana plateau Upper Devonian limestone is interbedded with volcanics, and along the south side of the Brooks Range Middle Devonian carbonates are succeeded by increasingly clastic Upper Devonian sediments and andesitic volcanics. Thus, by late Devonian time, the shelf area as far north as the Brooks Range had disintegrated into a mobile volcanic province typical of the early phase of geosynclinal development. This rather sudden change probably represented an encroachment of crustal mobility and deep fracturing from an area south of the Alaska Range onto the shelf. The areas along and north of the Brooks Range remained relatively stable until Mesozoic time.

The most complete section of early geosynclinal phase sediments is found in the Goodnews Arch. Here from Mississippian to Triassic time an estimated 10,000 feet of marine sediments were deposited, largely siltstone but associated with chert and limestone and, particularly in the late Paleozoic and Triassic, much greenstone. On the southern slopes of the Alaska Range, in the Wrangell Mountains, and along Cook Inlet, Upper Paleozoic greenstone and Upper Triassic limestone indicate the extension of the early geosynclines into the area. The lack of clastic rocks indicates the low relief during this period.

Further north, metamorphic rocks are common in the cores of the central uplifts and are a great source of confusion in the interpretation of the geologic history. These metamorphics were usually dated as older than the oldest nonmetamorphosed sediments by the early mappers. The latest Geologic Map of Alaska (compiled in 1954) shows these rocks to be predominently pre-Devonian Paleozoics, except for the Birch Creek schist which is shown as lower Precambrian.

The Birch Creek schist and associated gneiss which underlies a great area in the Yukon-Tanana plateau has long been dated as Precambrian. This was done on the basis of metamorphism and differences in lithology of the quartz mica schist relative to the Cambrian and Ordovician rocks which crop out locally near the margins of the metamorphic area. In earlier days it was reasonable to assume that the great mass of schist was older than the surrounding rocks which were unmetamorphosed. However, this simple conclusion is not very satisfactory at relating the known facts when the region is considered from a tectonic viewpoint. I would like to suggest a reinterpretation of the facts.

Along the northern margin of the Yukon-Tanana plateau of Devonian and Mississippian rocks are a eugeosynclinal assemblage containing considerable amounts of chert and greenstone. To the NE, across the Yukon River near the Canadian border, the rocks of the same age are a miogeosynclinal assemblage without any volcanics. Thus, during the latter half of the Paleozoic, the present northern boundary of the Yukon-Tanana plateau appears to have been the northern limit of a eugeosynclinal basin. The rocks along this northern edge have been unaffected by metamorphism due to lack of deep burial. Further south in the basin, in the area now occupied by the Birch Creek schist, thick deposition of shale, sandstone, limestone, along with some basic volcanics, took place. I would like to suggest that this thick pile is a typical early phase geosyncline which filled with sediments of Upper Paleozoic age. It underwent inversion during Mesozoic time with consequent regional metamorphism, folding, intrusion of granite, and uplift.

This interpretation of the origin of the Yukon-Tanana central uplift offers a simple explanation of the facts and is consistant with the history of better-studied regions outside of Alaska. From this point of view the belt of Devonian basic and ultra basic intrusives that cuts the Birch Creek schist is seen as part of the basic igneous activity of the early phase of geosynclinal development. The regional metamorphism and granite intrusion are part of inversion, the gneisses being early granites emplaced before the end of folding, while the nonfoliated granites were intruded after folding. As a result of uplift during inversion a clastic wedge was shed northward into the Kandik area during the Cretaceous.

In the Ruby geanticline and the Brooks Range the early mappers dated the metamorphic rocks as older than the oldest fossil-dated sediment, usually with some evidence of unconformities. The implication is that the metamorphic rock was the basement on which later sediments were laid down, the metamorphism having taken place at some early, possibly Precambrian, date. Recent detailed studies made in the Brooks Range by Brosgé and others indicates that the metamorphic rocks are of Upper Devonian age, younger than the oldest sediments, which are Middle Devonian. The metamorphics clearly cannot be the basement. This metamorphic belt extends across the southern edge of the Brooks Range and has been intruded by early foliated granites and late nonfoliated granites. It therefore has undergone inversion sometime after Upper Devonian time. Mapping by the U. S. Geological Survey north of the metamorphic belt indicates that up until Triassic time the source of sediments in the Brooks Range area was a highland north of the Range. This indicates that there were no large uplifts along the south side of the range during this period and thus that there was no large late Paleozoic or early Mesozoic inversion of the southern Brooks Range. Beginning in Jurassic time, however, inversion did occur and a large clastic wedge was deposited north of the Brooks Range.

The mere fact of regional metamorphism of the southern Brooks Range belt indicates that many thousands of feet of sediments overlaid the presently exposed Upper Devonian metamorphics at the time of metamorphism during the Jurassic. These sediments probably filled a deep east-trending trough which did not extend far toward the north as shown by the restriction of metamorphism to a rather narrow belt. That these sediments were eugeosynclinal is suggested by the presence of andesitic volcanic rocks in the Upper Devonian and by the later inversion of this geosynclinal trough -- behavior typical of eugeosynclines.

The Ray Mountains south of the Brooks Range are an extension of the Ruby geanticline and are made up of metamorphosed sediments and volcanics. These also appear to be an upper Paleozoic eugeosyncline which was inverted during the Mesozoic.

To recapitulate, the metamorphic belt along the southern Brooks Range was the site of a narrow east-trending upper Paleozoic eugeosyncline which was flanked immediately to the north by a parallel miogeosyncline with an eroding highland located still further north. Inversion of this eugeosyncline during Jurassic time resulted in a reversal of relief, with clastic wedges being shed onto the adjacent areas, north and south. The parallel with the Yukon-Tanana plateau is striking.

The Seward Peninsula is another of these metamorphosed central uplifts. Unmetamorphosed shelf limestone and shale of early to Middle Paleozoic age in the NW part are flanked on the SE by metamorphic rocks whose lithology was originally rather similar except for a larger proportion of clastic rocks and basic igneous rocks. No fossils have been found in the metamorphic rocks and their age is conjectural. In the metamorphic area both early gneissose granitic rocks and late nonfoliated granites are present. In my opinion this area was the site of an upper Paleozoic geosynclinal trough which underwent Mesozoic inversion, metamorphism, granitic intrusion, and uplift. The history of the Seward Peninsula is thus closely analogous to that of the Brooks Range.

I have been interpreting the early tectonic history of these areas partly on the basis of their later inversions, and clastic wedges shed as a result of inversion. This approach can be applied to the Aleutian Range-Talkeetna Mountains-Wrangell Mountains belt, hereafter referred to as the Talkeetna geanticline, which is another metamorphic-igneous belt flanked on both sides by Mesozoic clastic wedges which extend with interruptions from Kodiak Island to Yakutat and beyond on the south side and from the Nutzotin Mountains to the Mulchatna River (north of Lake Clark) on the north side. The clastic wedges, at least, suggest that this is a single belt interrupted by the Copper River and Susitna River Basins, an upper Paleozoic geosyncline inverted during the Mesozoic.

Rocks of the early phase geosynclinal trough ranging in age from Mississipian to Triassic crop out along the belt in a number of places. They are particularly well exposed in the Wrangell Mountains, also in the northern section of the Copper River basin, and sporadically in the northern Talkeetna Mountains.

The rocks in the northern Copper River Basin were warped up along the axis of the Talkeetna geanticlinal uplift. Subsequently during Cretaceous time the southern Copper River basin subsided, possibly as a compensation for the uplift of the Talkeetna Mountains, and was filled with Middle to Upper Cretaceous and Cenozoic sediments.

This analysis of the central uplifts indicates that they, and possibly the ranges along the Talkeetna geanticline, represent thick sedimentary and volcanic accumulations deposited during Upper Paleozoic time in geosynclinal troughs. These troughs were floored by lower Paleozoic limey shelf type sediments. During Middle Mesozoic time these thick geosynclinal piles were folded, regionally metamorphosed, invaded by granite, and uplifted. As a result of this uplift clastic wedges were deposited in adjacent areas during Middle to Late Mesozoic time.

This history indicates that the early Paleozoic sediments that crop out around the margins of the central uplifts are the basement rock, if such can be said to exist, and that the metamorphic rocks are younger products of Mesozoic orogenies rather than the oldest rocks, as they are still often mapped. Some of the margins of the central uplifts have, since Upper Paleozoic time, been sharply differentiated from the surrounding areas which are now the sites of basins and clastic wedges, so that these margins are likely to be important tectonic junctions. There is a tendency for the central uplifts to behave as blocks with recurrent movements and igneous activity along these junctions.

YOUNG PLATFORM STAGE

The Mesozoic clastic wedges were strongly folded during early Tertiary time, uplifted, and eroded to surfaces of low relief. After the folding had nearly ceased, these sediments, which generally do not contain interbedded volcanic rocks, were invaded by acid and basic igneous rocks which were emplaced as shallow intrusives and extrusives. This igneous activity is the result of deep fracturing and indicates consolidation of the region into a brittle young platform. The age of the igneous rocks is only poorly known but belts of granitoid stocks that were probably intruded in Miocene time cropped out on the Late Tertiary erosion surface.

At the end of the Tertiary the Mesozoic central uplifts were gentle hills surrounded by flats. The patterns of the major rivers were controlled by the location of the hills. Thus the Yukon flowed along the northern edge of the Yukon-Tanana central uplift at Eagle, and after crossing the Yukon flats continued southwest along the edge of the Ruby geanticline and finally crossed the geanticline along the course of a major fault. The Kuskokwim cuts around the south end of the Ruby geanticline. Since late Tertiary time the lowlands underlain by clastic wedge deposits have been uplifted slowly enough to enable the rivers to maintain their courses across the mountains that were formed. Examples are the Kuskokwim River's course across the Kuskokwim Mountains, the Chisana across the Nutzotin Mountains and the Susitna's course through the northern Talkeetna Mountains. The late Tertiary erosion surface on which these rivers flowed has been preserved over large areas as accordant summit levels which stand up above a younger rolling surface which in turn stands above the basins, thus indicating two stages of uplift of the mountain blocks since late Tertiary time. These block uplifts are responsible for much of the present topography.

TECTONIC CONTROL OF ORE DISTRICTS

The three major ore deposits that have been found to date in Alaska are all near arcuate tectonic lineaments. Each is near the edge of one of the Mesozoic metamorphic-igneous belts of inversion. The Alaska Juneau Mine lies near the western edge of the Coast Range igneous-metamorphic belt that extends along the west side of the Coast Range batholith for several hundred miles. Kennecott lies along the southern margin of the Talkeetna geanticline, the site of much faulting and igneous activity. Ruby Creek lies near the southern edge of the southern Brooks Range metamorphic belt.

The Iditarod fault in the Kuskokwim region is a major arcuate fracture of Tertiary age which has localized Tertiary volcanics and a number of granitic stocks with associated ore. The Flat, Nyac, and Candle placer camps, several quicksilver deposits, possibly the Goodnews Bay platinum placer, and some other smaller mining camps are located along this break. The Farewell fault, an apparently similar tectonic fracture approximately 70 miles southeast of the Iditarod fault has a number of intrusives and known mercury, lead, zinc, and gold deposits along it. The two best known deposits along the Farewell fault are in McKinley Park, in or near intrusive rocks. The control of granitic stocks by deep fractures and the preferential location of ore deposits in stocks along fractures seems to be indicated by the pattern of ore deposits in the Kuskokwim region. Certainly a more than average concentration of ore deposits occurs along these faults.

One of the principal conclusions of the early mappers for the U. S. Geological Survey was that the widely scattered placer camps in the Interior were related to granitic stocks. In many of the camps the ore minerals are gold, scheelite, cassiterite, stibnite, and cinnabar. These indicate temperatures of deposition ranging from high to low in a small area, typical of telescoped deposits around shallow intrusives. The rich placer deposits have been due to stream concentration of many small veins, and to date no large lode deposits have been found in these camps. It seems likely that recurrently active major stuctures in these placer camps would increase the possibilities for large lode deposits. One example of a placer camp on a major structural zone with a typical association of placers containing gold with a little galena and cinnabar near a granitic stock is the Kennecott area. The intrusive is not generally considered to be the source of the copper at the Kennecott mine, but it is likely the two are related, at least by a common source or a common structure.

The concentration of the mineral deposits around the Wrangell Mountains along the faulted northeast and southwest sides provides a good example of the localization of ore along boundaries of tectonic blocks. The lack of visible control by major faults in these areas illustrates the indirect connection of tectonic fractures to ore deposits. Willow Creek, located along the southern edge of the Talkeetna central uplift, offers a somewhat more direct connection. In this district, gold deposits in quartz diorite are controlled by minor faults which parallel the major Castle Mountain fault along the southern edge of the uplift.

Postmagmatic ore deposits are thought to form when cooling intrusives are cut by faults at the proper time. Such juxtapositions of faulting and igneous activity should occur with greatest frequency along tectonic lineaments, particularly those at the margins of the central uplifts. The lineaments of particular interest for mineral deposits are those marked by belts of intrusives and extrusives. This igneous activity indicates that deep layers of the crust have been tapped by fracturing. Faulting at the surface along these zones may or may not be evident. Typically the igneous activity occurs in isolated centers just as ore districts are usually isolated centers. I believe that these isolated igneous centers along tectonic lineaments have significantly greater than average probability for ore deposits.

In assessing the ore possibilities of interior Alaska, even using the possibly erudite methods of tectonic analyses, it is well not to overlook any clues. The mineral industry of Alaska has largely resulted from conditions during the Cenozoic which were particularly well suited for making concentrations of placer gold. Areas with only scattered small gold veins or with a little gold associated with base metal deposits may contain placer deposits. Both Ruby Creek and Kennecott have gold placers nearby. The areas around even small gold placer districts have a better than average probability for containing base metal deposits.

General criteria for ore favorability that have been mentioned here are: (1) areas along tectonic lineaments, (2) areas along linear igneous belts (intrusive and/or extrusive), (3) areas along margins of central uplifts, and more specifically, (4) areas around (small) granitoid intrusives along any of these belts, and (5) areas near placer gold deposits.

EXAMPLES OF FAVORABLE AREAS, BASED ON TECTONIC CHARACTERISTICS

The north-trending Haycock igneous belt that separates the Seward Peninsula from the Koyukuk geosyncline contains a number of placer creeks. The pre-Cretaceous and Cenozoic volcanics and Mesozoic granitic intrusives indicate recurrent deep fracturing along the margin of the Seward Peninsula block; and placer deposits on a number of creeks indicates mineralization in the area. Platinum and base metals occur in some of the placers. Further west another igneous belt trends north from Cape Darby. Here Mesozoic granitoids are intrusive into limestone-schist bedrock. Lead-silver mineralization including the Omilak deposit lies near this zone. The geology is somewhat similar to that of the southern Brooks Range metamorphic belt which contains the Ruby Creek deposit.

Southwest of Nyac where some placer gold has been found, the Iditarod fault zone contains several different kinds of intrusive and extrusive rocks, all of Tertiary age. Deep fracturing has evidently been recurrent in the area, and the possibility of finding economic deposits appears to be good.

The Farewell fault between Farewell and Swift River separates the early Paleozoic limestone from Cretaceous clastic wedge deposits. Within the last few years cinnabar has been found in the limestone and some placer gold is known in the area. Any granite bodies along this fault (there is at least one present) near the cinnabar would indicate favorable areas.

Further southwest along the Farewell fault in the Tikchik Lake region, scattered granite intrusives are centered around a large domal area. The fault cuts along one side of the dome and should provide local structures favorable for ore deposits.

Along the north side of the Talkeetna geanticline four small granitoid intrusives with associated molybdenum and/or copper are known. These are the Orange Hill copper-molybdenum deposit north of the Wrangell Mountains; the molybdenum deposit on Ahtell Creek in the Slana district; the molybdenum deposit at Portage Creek, north of the Talkeetna Mountains; and the Hayes Glacier molybdenum deposit west of the Susitna lowland. The geology of the area is not too well known but the location is analogous to that of the porphry copper and molybdenum deposits in British Columbia, and it seems possible that this may be a porphyry belt.

North of Lake Minchumina a belt of Cenozoic intrusives and extrusives extends in a northerly direction for approximately 60 miles. This igneous belt lies at the eastern edge of the metamorphic rocks of the Ruby geanticline and probably marks the location of a tectonic fracture along the margin of this old central uplift. Only a little placer gold has been found, perhaps due to the deep overburden in the creeks, and not much prospecting appears to have been done. This area is analogous to the igneous belt along the eastern margin of the Seward Peninsula and has a similar mineral potential.

I have attempted to outline a coherent succession of tectonic events that have shaped the geology of Alaska since mid-Paleozoic time, stressing the development of the central uplifts as the major tectonic units in Interior Alaska. I have also emphasized the importance of deep crustal fractures as guides to ore, particularly those fractures localized along the margins of the central uplifts. I believe that tectonic thinking along the lines used here can give a sense of direction to exploration and regional geologic investigations.

TERRITORY OF ALASKA

DEPARTMENT OF MINES

COLLEGE, ALASKA

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PRELIMINARY REPORT

NIXON FORK MINING DISTRICT, ALASKA

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(Mt. McKinley Recording District)

1948

By

Bruce I. Thomas
Associate Mining Engineer.

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TERRITORY OF ALASKA

DEPARTMENT OF MINES

COLLEGE, ALASKA

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Quote to Frank Metcalf. Terr. Hway Engineer April 18 '50

SUMMARY

Approximately 149 feet of adit and 42 feet of shaft expose a mineralized zone about 27 inches in width at the Eagle Creek gold-lode prospect. Samples taken across the exposed face in the adit, by an engineer of the Territorial Department of Mines, average $60.83 a ton in gold. The underground workings have not proven the strike length of the mineralized body.

The geology of the Eagle Creek gold-lode prospect is similar to the geology in the Jumbo Peak area of the Nixon Fork District. In the Jumbo Peak area mineralized zones occurring along the contact between limestone and monzonite are classed as contact metamorphic and hypothermal replacement deposits. These deposits are composed of high grade, irregular shaped, discontinuous ore bodies of limited length. Irrespective of their size and form they have been mined at a profit on a small scale for several years. The Eagle Creek gold-lode prospect is a contact metamorphic deposit and further development work should prove that it too can be mined profitably on a small scale.

Preliminary examination and testing indicate the mineralized zone to contain "free milling" gold. A good recovery should be obtained by amalgamation methods.

Lode and placer mining have been confined to the immediate vicinity of Jumbo Peak in the Nixon Fork District. The discovery of the Eagle Creek gold-lode prospect discloses the presence of a gold bearing zone approximately six miles from this center of mining activity. It is very likely that prospecting will reveal the presence of other gold occurrences that are of equal distance or farther from this locality.

Detailed geologic studies and well planned exploration and development programs should reveal the presence of commercial ore bodies in existing lode mines of the district. Known placer deposits are worthy of exploration with a view of expanding known paystreaks. Bulldozers, diesel pumps and other modern machinery used by the Alaska placer miner have never been introduced into this district; it is entirely likely that their introduction would be the dominant profit factor.

INTRODUCTION

During August 1948 Bruce I. Thomas, Associate Mining Engineer, Territorial Department of Mines, made a preliminary examination of a lode-gold prospect at Eagle Creek in the Nixon Fork District, Alaska. (Figure 1.) This property is the result of a recent discovery and the examination was conducted as part of the Territorial Department of Mines program of giving technical assistance to prospectors and small-mine operators in Alaska.

In conjunction with the Eagle Creek examination a general reconnaissance was made of the lode and placer mines in the vicinity of Jumbo Peak. The Mespelt Mine, the principal and long-time producer in the district, was closed and the underground workings were not open for examination. The underground workings of other mines were also inaccessible. It was impossible to inspect the physical condition of the lode mines in the area.

The gold placer properties in the vicinity of Jumbo Peak were inactive with the exception of two small-scale hand-operations. Placer mines in the area were active prior to the discovery of lode deposits; the presence of coarse rough gold near the head of the gold bearing streams led to the search and their ultimate discovery.

The Territorial Department of Mines extends special acknowledgement to Mr. & Mrs. B.A. "Bob" Stone, Mr. & Mrs. Clinton Winans, Mr. John Strand and Mr. E.M. Whalen of Medfra for the courtesies and kindnesses extended to the engineer during the time of the examination. Special gratitude is extended to Mr. A. Mespelt of McGrath for providing necessary transportation facilities while in the area.

LOCATION AND ACCESSIBILITY

Mining and prospecting activity in the Nixon Fork Disctrict is confined within a small area between a large headwater tributary of Nixon Fork and the North Fork Kuskokwim River. This area is approximately 12 miles long and 8 miles wide and lies between parallels 63° 08' and 63° 18' and meridians 154° 40' and 154° 55'. The nearest settlement is Medfra which is located at the head of navigation on the Kuskokwim River. Medfra has a small general store, postoffice, roadhouse, and airfield which is cabable of accomodating small airplanes. A telephone system and a truck road connect the mines in the Jumbo Peak area with Medfra. The road is approximately 12 miles in length and is maintained by the Alaska Road Commission with funds provided by the Territory of Alaska. The telephone system is maintained by the mine operators.

The Eagle Creek gold-lode prospect is located at the head of Eagle Creek which is located in the southwest corner of the area and is approximately 8 miles northwest of Medfra. (Figure 2). A crude tractor trail connects the prospect with the truck road at a point approximately one mile north of Medfra. This trail is well defined and easily traversable on foot throughout the entire length; about 3½ miles follow along the old Nenana-McGrath winter road. A truck road could be constructed along this route by staying along the hill slopes and on the ridges.

A small radio station is located at Eagle Creek and daily communication is maintained with commercial stations at McGrath. This is the only operating radio station in the district at the present time.

Supplies and machinery are shipped from the states by ocean steamer to Bethel thence up the Kuskokwim River by boat and barge to Medfra. The cost of freight, including insurance, handling charges and wharfage, on general merchandise shipped from Seattle via this route to Medfra is approximately $120.00 a ton. Air freight from Fairbanks to Medfra is 10¢ a pound and passenger fare is $35.00 per person. A special air freight rate of 7¢ a pound on large shipments from Anchorage to Medfra can be obtained. Diesel oil and gasoline cost about 19½¢ and 25¢ a gallon, respectively, at Bethel.

The Nixon Fork District is located in the Mt. McKinley Precinct and Recording District. The recording office is located at McGrath, which is approximately 30 miles west of Medfra.

PHYSICAL FEATURES AND CLIMATE

The mines and prospects in the Nixon Fork District are in an area of low rounded hills that form the north front of the broad expansive valley of the North Fork Kuskokwim River. The Eagle Creek prospect is about 800 feet above sea level and the lode mines in the vicinity of Jumbo Peak are approximately 1,500 feet in elevation. The upper portions of the streams that cut into the mineralized area have steep gradients and are confined within narrow "V" shaped valleys. At the lower ends they meander across broad expansive valley floors.

Alder, poplar, birch, spruce, and moss, blueberry and cranberry grow along the tops of the rounded ridges and along the valley walls.

Fairly large spruce, 2 feet in diameter or more, grow along stream courses and near the bottom of the hill slopes. Dwarf spruce is generally found in areas of permanently frozen ground while thick patches of willow, alder, and some birch and poplar grow in areas of permanently thawed ground. Willow and alder is generally found in damp ground along the banks of streams.

Von Frank Mountain, northeast of the district, is a prominent land mark in this region. The mountains between this peak and the mining area are quite rugged and are from 2,000 feet to 3,000 feet in height. The hills to the west of the district are low and well rounded.

The mineralized areas at the head of Eagle Creek and in the vicinity of Jumbo Peak are covered with 5 to 6 feet of overburden. Thorough prospecting requires the excavation of many trenches and pits in these sections.

The climate is subarctic and is characterized by long cold winters and relatively short warm summers. Winter temperatures are ofttimes -60° to -70° F. and the summer temperatures are as high as 85° to 95° F. The precipitation in this region appears to be slightly more than elsewhere in adjacent regions. During the rainy season there is sufficient water for both large and small placer mining operations but during the dry season placer mining practically stops entirely. There is sufficient water at Eagle Creek for continuous operation of a small mill, 35 to 50 tons capacity, both summer and winter. This mill could be constructed at the head of the creek within 800 feet of the mineralized zone. In the Jumbo Peak area sufficient water may be obtained from Hidden and Ruby Creeks for year around milling operations.

LABOR AND LIVING CONDITIONS

A few prospectors and miners comprise the entire population of the district. Miners and other skilled workmen are brought into the district from other more populated areas of interior Alaska.

Medfra is the principal trading center for many Indians who trap in the adjoining regions. Most of the Indians live at Nicholai which is about 16 miles upstream from Medfra at the confluence of the South Fork and the Kuskokwim River. Many of the Indians are good workmen and can be trained to do semi-skilled work at the mines.

Two small log cabins, one near the prospect and the other about ¼ mile away, constitute the principal buildings at and near the Eagle Creek prospect. These cabins are used as living quarters at the present time. A bunkhouse, mess house and two homes comprise the living facilities at the Mespelt Mine in the Jumbo Peak area. Several cabins are located at the sites of the present and erstwhile placer mining operations. A roadhouse at Medfra provides quarters and board for travelers in and out of the district. There are also several cabins at Medfra that are used by various prospectors and trappers from time to time.

There is no permanent population at Medfra with the exception of the trader and roadhouse operator. This locality serves solely as a distribution center for the prospectors, miners, and trappers.

HISTORY AND PRODUCTION

Placer gold was discovered on Hidden Creek in June 1917 and discoveries were made soon thereafter on Ruby, Mystery and Submarine Creeks. Coarse rough gold found at the very head of these streams stimulated the search for the bedrock source. The Crystal lode was discovered at the head of Ruby Creek in 1918. Several hundred tons of high-grade ore were mined and shipped to the Tacoma Smelter during 1919 and 1920 from this property. During the interum many signs of mineralization led to the staking of many claims. In 1920 the Treadwell Yukon Co., Ltd. leased and purchased several claims and in 1921 they erected a ten ton stamp mill at the head of Ruby Creek. Production started immediately after the erection of the mill and continued until 1923 at which time the company discontinued the operation. The property and mill owned by this company ultimately passed to the Mespelt brothers who have operated almost continuously up to the present time.

It is estimated that over $2,000,000 dollars in gold has been produced from the lode and placer operations in the Jumbo Peak area. Approximately $1,700,000 was produced from the lode mines and approximately $300,000 from the placer mines.

Placer mining on a small scale preceeded the discovery of the lode-gold prospect at the head of Eagle Creek. Mining was done by hand methods in the early 1920s. The presence of placer gold stimulated the search for its bedrock source as was the case in the Jumbo Peak area. It was not until 1941, however, that the presence of lode gold deposits attracted any attention in this section. A small amount of development work has been done in recent years.

It is estimated that the placer gold production in the Eagle Creek area has amounted to but a few thousand dollars. There has been no gold production from the lode deposits in the area.

PROPERTY AND OWNERSHIP

Lode and placer claims are described in the files of the recording office at McGrath.

Jumbo Peak Area

Placer mining claims are owned by the following people: Hidden Creek, C.M. Winans, Medfra; Holmes Gulch, E.M. Whalen, Medfra; and Ruby Creek and Crystal Gulch, John Strand, Medfra.

The Mespelt Mine and mill at the head of Ruby Creek is owned by the Mespelt brothers, Charles and Adolph. Adolph Mespelt lives at McGrath. The Whalen Mine at the head of Holmes Gulch is owned by E.M. Whalen and Associates, Medfra.

Eagle Creek Area

Placer claims at the head of Eagle Creek are owned by B.A. "Bob" Stone, Medfra, and J.E. Dunn, McGrath.

Four lode claims, approximately 1,500 feet long by 600 feet wide, the Eagle Head, Big Bertha, Mistake and Damfino are owned by B.A. "Bob" Stone, Medfra, and J.G. Bayless, Fairbanks. These claims cover the Eagle Creek gold-lode prospect.

GENERAL GEOLOGY

The country rock in the vicinity of the mining and prospecting areas consists of limestone, sandstone and shale. Two main intrusive masses of quartz monzonite appear to have invaded the sedimentary rocks of the areas namely in the vicinity of Jumbo Peak and Eagle Creek to the southwest. In these two localities limestone is the predominant sedimentary rock. Mineralization occurs in crystalline limestone near the contact of the quartz monzonite. The intrusive mass at Jumbo Peak is roughly elliptical in shape; and is about five miles in length and two miles in width; at Eagle Creek only a very small portion of the intrusive mass has been outlined. The intrusive masses in both localities are probably the roof pendants of a large granitic batholith that have been exposed by erosion.

OCCURRENCE OF ORE DEPOSITS

John S. Brown, Geologist, U.S. Geological Survey, makes the following statements relative to the general features of the principal lodes in the Nixon Fork District:1/

"The ores of the three lode claims above described, which constitute the only notable claims in the district, are of the type commonly called contact or contact-metamorphic deposits, such as are formed typically around the borders of an igneous intrusive mass, especially in limestone wall rock. The ores were deposited from rising solutions given off from the monzonite as it cooled and crystallized. These solutions were fairly hot. They contained gold and copper and carried much silver and other common substances. On reaching the limestone they found a favorable place to deposit their heavy mineral content, and they penetrated along any convenient fractures, bedding planes, or cavities, irregularly replacing the limestone, altering it to quartz and silicates and depositing copper and gold.

1/ U.S.G.S. Bulletin 783-D " The Nixon Fork Country" by John S. Brown.

"Such ore bodies are usually irregularly distributed more or less along the contact but in places even several hundred feet from it. They occur in localized ore shoots or bunches, and the valuable material is generally spotty. Most of the ore bodies seem to have been rather small, generally less than 100 feet in lateral or vertical extent, and other ore bodies that may be discovered will probably be of similar dimensions."

J.B. Mertie, Jr., Geologist, U.S. Geological Survey, described the mineralization of the lodes in the vicinity of Jumbo Peak in the following manner: 2/

"The principal gold lodes lie at or near the contact of this intrusive (monzonite) mass with the Paleozoic limestone, and most of those so far discovered occur in the limestone, though few of them are more than 100 feet from the contact. As these lodes occur on low ridges where outcrops are lacking, and as the underground work has been done mainly in bodies of ore, the contact relations between the intrusive and country rocks are not well known. Sufficient work has been done however, to show that the western margin of the quartz monzonite, along which the lodes occur, is very irregular in outline and has numerous apophyses. It is also apparent that this irregular contact line has been further modified by cross faulting, some of which occurred prior to the deposition of the ores. In fact, it seems probable that the ore-bearing solutions followed fault planes as well as contact planes in their upward migration.

"The lodes consist of irregular-shaped masses of ore, which have no definite boundaries but fade out into less mineralized or unmineralized country rock. Some of these ore bodies are roughly lens-shaped or disk-shaped. Most of them, regardless of their shape, have vertical or horizontal dimensions of less than 100 feet. In addition to irregularity in shape there is a marked irregularity in the distribution of gold in them, for the ore commonly occurs in irregular-shaped shoots, of varying value, within a generally mineralized ore body. The methods employed for following and recognizing ore of workable grade differ at different properties, for at some places the prevalence of copper minerals is an index of high gold content, and at other places the reverse is true.

"The ores consisted originally of gold-bearing copper and iron sulphides but have been extensively altered by processes of surficial oxidation, so that much of the gold has been released from the sulphides and now occurs as free gold recoverable by amalgamation. Most of the operating shafts so far sunk have shown this mixture of free gold and oxidized sulphides, but the ratio of oxidized to unoxidized ores differs in different ore bodies. Thus, the ore at the Whalen mine is described as being almost wholly

2/U.S.G.S. Bulletin 864-C "Mineral Deposits of the Ruby-Kuskokwim Region Alaska" by J.B. Mertie, Jr.

oxidized, whereas in the Crystal lode, at the head of Ruby Creek, the ore consisted of unoxidized or little-oxidized chalcopyrite, pyrite, and bornite. The oxidized ores consist largely of the basic carbonates of copper and oxides of copper, intimately mixed with iron hydroxides. These oxidized ores have also doubtless been materially enriched by surficial processes, and as a result of such conditions it is to be expected that the ores will not only become leaner with depth but will also contain less free gold and will therefore become progressively less adapted to free milling. Inasmuch, however, as present mining operations have not extended below the zone of oxidation, and much surficial prospecting and mining remains to be done, this matter of decreasing tenor and increasing refractoriness with depth at present merits only placing on record for future consideration.

"No detailed studies have been made regarding the origin and paragenesis of these ore minerals. Some thin sections of the main intrusive mass and of the ores and wall rock have been examined by the writer. From these it is apparent that the intrusive mass away from the contact, consists of a hypidiomorphic granular rock composed essentially of quartz, feldspar, and mafic and accessory minerals. The feldspar consists of orthoclase and plagioclase near andesine, and these two minerals occur in approximately equal proportions. The mafic minerals unlike those in some of the other Tertiary monzonite rocks of this region, show little evidence of crystallization as pyroxene but, instead, consist of either biotite or mixtures of biotite and hornblende. The accessory minerals are principally apatite, titanite, and iron ores. This rock is obviously a quartz monzonite, and this determination has recently been confirmed by a chemical analysis. No specimen of the quartz monzonite where it has been altered by ore-bearing solutions was available for examination, but one fine-grained dike below the 70-foot level in the High Grade shaft, against which the ore lay, was found to be so extensively silicified and sericitized that only the faintest outlines or ghosts of preexisting feldspars could be discerned.

" Most of the oxidized ores, regardless of their composition, are green or greenish yellow, except those containing azurite, which are mottled green and blue. They are lusterless and earthy in appearance, and the fully oxidized ores look more like stained country rock than ore. Thin sections of some of the oxidized ores show a mixture mainly of calcite, iron hydroxides, and copper carbonates, with considerable sericite and quartz in some specimens and also more or less pseudo-isotropic chlorite. These minerals occur in part in a lamellar arrangement and in part in an irregular fashion suggestive of metasomatic replacement. This ore is evidently in large measure a limestone that has been replaced by ore minerals. Another type of ore, which occurs sparingly at the Mespelt property, is very fine grained and consists largely of epidote and subordinately of zeolites and other minerals. This rock contains many minute fractures, which are filled with iron hydroxides and copper carbonates. Another unusual type of ore that occurs in small amounts on the Southern Cross and Texas claims consists mainly of calcite, iron hydroxides copper carbonates, garnet, epidote, and sericite.

"The ore that has been mined at the several properties has probably ranged from $15 to several hundred dollars a ton, but the average value of the ore at the Mespelt property is probably between $25 and $35 a ton. (All these figures are based upon the old value of gold.) Besides gold the ore carries from 1 to 15 ounces of silver to the ton, and as only a small part of this is alloyed with the gold, most of it must occur in other forms. No free silver is believed to be present, as no native silver has been recognized and no silver nuggets are found in the placers derived from these lodes. It is therefore believed that silver or silver-bearing copper or lead minerals must be present in the unoxidized ores. The ore carries from 2 to 12 percent of copper, largely in the form of chalcopyrite and bornite in the primary ores, though a little chalcocite has been noted. In the oxidized ores the copper occurs mainly as malachite, azurite, and black earthy oxides of copper. A small amount of native bismuch also occurs in these ores, but numerous large bismuch nuggets are of common occurrence in the stream placers. One of these bismuch nuggets was analyzed in the laboratory of the United States Geological Survey for the metals golds, silver, and copper, but none of these were detected. Unlike the ores associated with the monzonitic rocks elsewhere in the Ruby-Kuskokwim region, these ores contain no cinnabar or stibnite, nor are these minerals found in the derived placer concentrates.

"The wall rock is a fine-grained recrystallized limestone, locally much iron-stained but not in general greatly silicified or otherwise altered. In places, however, mining operations have exposed bands of highly altered wall rock containing typical contact-metamorphic minerals. Several samples of such rock from the High Grade shaft, on the Mespelt property, showed considerable variation in granularity, ranging from coarsely crystalline to aphanitic, but all of them consisted essentially of garnet, diopside, and epidote, with more or less calcite, zeolites, and apatite. A metamorphic aureole in the limestone near the quartz monzonite at the Whalen property is essentially a granular mixture of epidote (both pistacite and clinozoisite) and pyroxene, together with zeolites, titanite, apatite, sericite, calcite, chlorite, and a copper carbonate.

These characteristics of the intrusive rock, the ores, and the wall rock suggest that the Paleozoic limestone, or country rock, was extensively recrystallized at the time of the monzonitic intrusion and was locally silicified and silicated by contact metamorphism. It does not follow, however, that the ores are of contact-metamorphic origin. On the contrary, their general character suggests that they originated at a later stage in the intrusive sequence and were formed by the replacement of limestone by sulphide ores, which were derived from hypogene aqueous ore-bearing solutions. The presence of garnet, pyroxene, and apatite in some of these ores, however, suggests that these, at least, were high-temperature hydrothermal deposits, but the duration of the mineralizing process is not known, and most of the ores may have been formed at considerably lower temperatures."

Vermiculite, identified by the Territorial Department of Mines, occurs in the ores of the Whalen Mine. Vermiculites secondary minerals resulting from the hydrothermal alteration of the micas biotite and phologopite, are hydrated silicates in part closely related to the chlorides but varying somewhat widely in composition.

The gold-bearing mineralized zone at the Eagle Creek prospect is approximately 90 feet from the quartz monzonite. Free gold occurs with a small amount of pyrite, limonite, siderite, calcite, and some quartz. No copper carbonate or copper sulphide minerals have been identified. Garnet, epidote, actinolite, chlorite and sericite are also found in the mineralized zone. The contact line here, as elsewhere in the district, has been modified by cross faulting. The abundance of iron oxides and iron carbonates indicate that the processes of oxidation were active in the mineralized zone. The high temperature minerals garnet, epidote and tremolite are characteristic contact metamorphic minerals and here serve to classify this deposit. No detailed studies have been made to verify the classification and no attempt has been made to trace out the succession in which the minerals have developed in the ore zone. Such studies would serve to definitely establish the type of deposit. The limestone along the contact has been altered by the quartz monzonite intrusion producing various silicious phases which grade outward from the igneous mass into pure white crystalline limestone. (Figure 3).

SAMPLING AND ASSAYS

Two channel samples 4" wide and 3" deep were cut across the true width of the mineralized zone in the face of the adit. The entire samples were retained for assay.

Weighted value and tabulated results are shown in Table I.

Grab samples were taken from material extracted from a small trench at the bottom of the shaft and a large stock pile estimated to contain 20 tons of ore. The results of assays are listed in Table II.

TABLE I

Sample No.	Ounces Per Ton		Value Per Ton	Width of Zone
	Gold	Silver		
Stone 103	2.96	Trace	$103.60	25"
Stone 104	0.72	Trace	25.20	30"

$$\begin{array}{rlcr} 25'' & \times\ 103.60 & = & 2590.00 \\ 30'' & \times\ 25.20 & = & 756.00 \\ \hline 55'' & & & 3346.00 \end{array}$$

$$\frac{3346}{55} = \$\ 60.83$$

TABLE II

Sample No.	Ounces Per Ton Gold	Silver	Value Per Ton	Sample Location
Stone 101	1.20	Trace	$42.00	From dump near collar of shaft
Stone 102	0.34	Trace	11.90	Dump near small trench
Stone 106	0.47		11.45	Large stock pile

All assays were made by A.E. Glover, Assayer Territorial Department of Mines Assay Office, College, Alaska.

The present exposures do not permit estimate of ore reserves.

DEVELOPMENT AND UNDERGROUND WORKINGS

The underground workings in the vicinity of Jumbo Peak were inaccessible. It is reported that the shaft at the Mespelt Mine was sunk to the 460 foot level during 1947-1948. A small block of ore was mined from this level before the property closed down. The Whalen Mine has been closed for several years and mining operations at the McGowan-Mespelt property were also discontinued several years ago. No development is in progress on placer properties.

The principal development work at Eagle Creek consists of 149 feet of adit and 42 feet of shaft. The general direction of the adit is north; it advances toward the downward projection of the shaft. The entrance is at the contact between quartz monzonite and limestone. The contact zone is followed for approximately 30 feet. The ground is loose and the adit is well timbered for this distance. At this point the adit swings 22° east into altered limestone; from here it is untimbered and stays in limestone throughout the remaining distance, 119 feet, to the face. One large water course and four faults are cross cut before the mineralized zone is encountered at the face. (Figure 3).

The shaft is reported to be 42 feet deep and to follow the mineralized zone throughout the entire depth. It was sunk at the site of the original discovery. At the present time the shaft is iced up and only a portion of the upper 15 feet is open to permit partial inspection of the walls.

The adit was driven with the intention and sole purpose of cutting into ore encountered at the bottom of the shaft.

Several small surface trenches have been dug near the site of the original discovery. Some ore has been recovered from float encountered in the overburden and near bedrock.

EQUIPMENT

Eagle Creek

Equipment at Eagle Creek gold-lode prospects consists of: 1 small gasoline powered 2-stage portable compressor, 1 small jack hammer, air hose, assorted blacksmith tools, picks, shovels, wheelbarrow and various small hand tools. There is a limited amount of air pipe and no mine rails or mine car.

Mespelt Mine

Most of the equipment at the Mespelt Mine was brought into the district by the Treadwell Yukon Co., Ltd., in 1921 with the exception of a few pieces of equipment which were purchased in recent years.

Mining equipment consists of the following: gasoline powered mine hoist and single stage compressor, steel hoisting bucket, blacksmith equipment, various small tools such as wrenches, shovels, picks, etc., 1½ ton truck and a 1 ton truck, small gasoline crawler tractor.

Figure 4 is a diagramatic sketch showing the flow sheet and equipment used in the mill. In recent years a diesel tractor with power take-off was used to operate the stamp mill and crusher only. The steam plant was not used.

PRESENT OPERATIONS AND PROPOSALS

Placer mining has been conducted in the district by hand and hydraulic methods for many years. For a short period during the 1930s a mechanical scraper powered with a steam hoist was used in conjunction with mining the placer at Hidden Creek. This scraper was the only piece of mechanical equipment used for placer mining in the district.

It is very possible that prospecting may develop reserves worthy of mining with equipment used by the present day placer miner.

Insufficient water during dry periods of the season has imposed a handicap. However, sufficient water is usually available to permit return of sluice water with diesel operated centrifugal pumps.

The characteristic of the lode deposits in the district has made it necessary to restrict mining operations to a limited basis. The limited size of the ore bodies has made it necessary to keep exploration and development well in advance of ore extraction to permit continuous operation on a limited scale. The near surface ore bodies have proven, in the past, to be the richest. The mantle of overburden covering the mineralized areas has made it necessary to do considerable surface trenching in order to locate mineralized zones. Trenching has always been conducted by hand methods. Bulldozers would expedite and lessen the cost of surface prospecting. Surface exploration should prove the existence of more ore bodies in both the Jumbo Peak and Eagle Creek areas.

The most favorable areas in the district in which to prospect are along the contact between quartz monzonite and limestone. It is suggested that preference when prospecting for lode or placer be given to localities containing these rocks.

Carbonate rocks such as limestone are most affected by intrusions of magma and have proven to be most favorable host rocks for the formation of metaliferous deposits. Mineralization usually follows closely along the contact between the limestone and igneous rock , however ore bodies are often formed in the limestone several hundred feet away from the contact. Faults that extend outward and upward from the intrusion serve as channelways that conduct mineral-bearing solutions far from the intrusive mass.

Various contact metamorphic effects are produced from magmas of differing composition. The most favorable igneous rocks for the formation of ore deposits of this type common to this district are quartz monzonite,

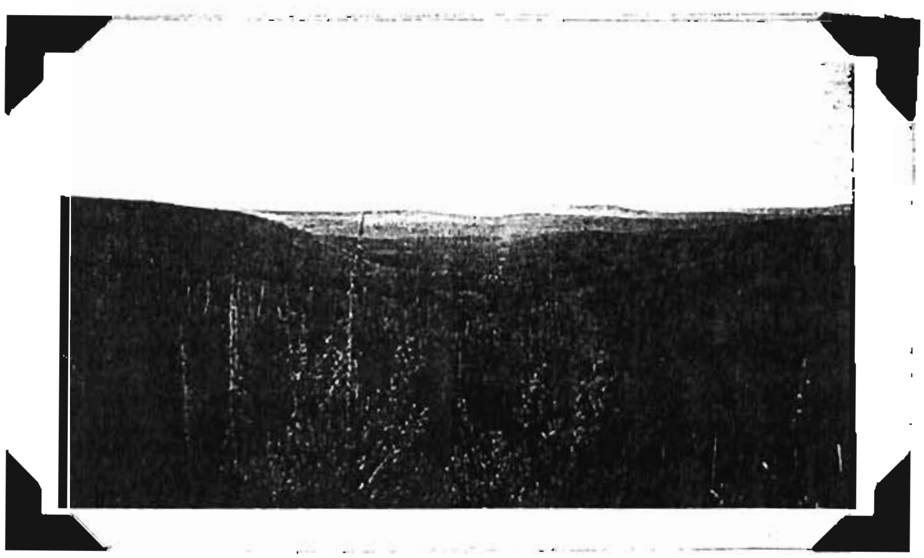
monzonite, granodiorite, and quartz diorite. Contact metamorphic deposits are seldom developed from highly silicic rocks such as granit and seldom with basic rocks and never with ultra basic rocks.

Roof pendants and apophysis are good localities for the concentration of ore bodies and such areas are worthy of the prospectors and miners strictest attention.

The most outstanding feature of contact-metamorphic and hydrothermal replacement deposits is the fact that ore bodies when encountered are usually high grade but of limited extent. Without numerable working faces the mining of such deposits is not profitable unless conducted upon a limited scale.

APPENDIX

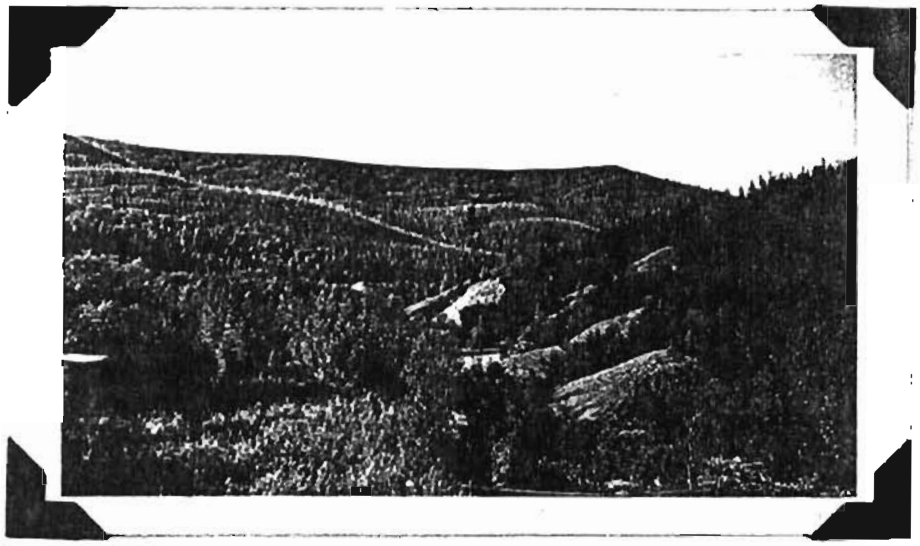
Compressor house foundation Eagle Creek Prospect



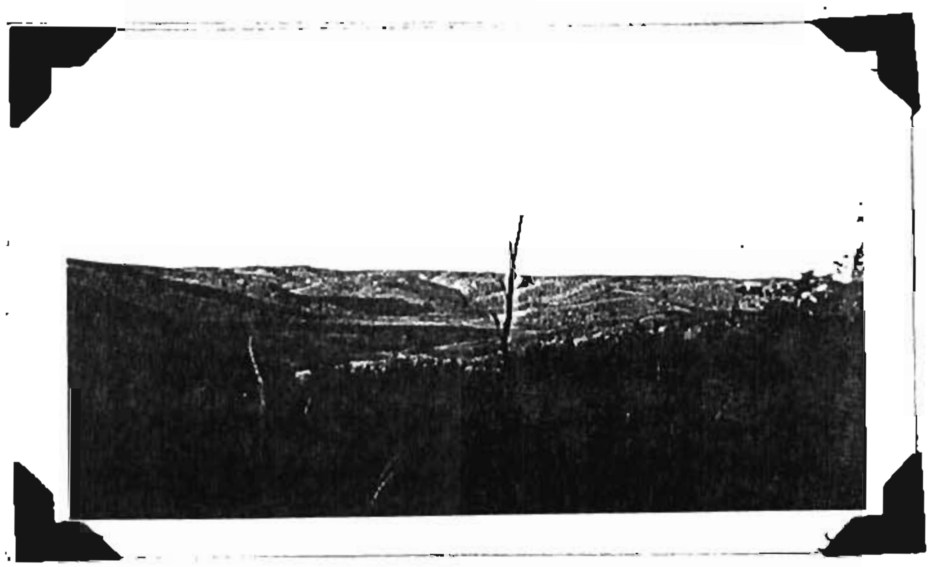
Down Eagle Creek

Down Minnie Creek

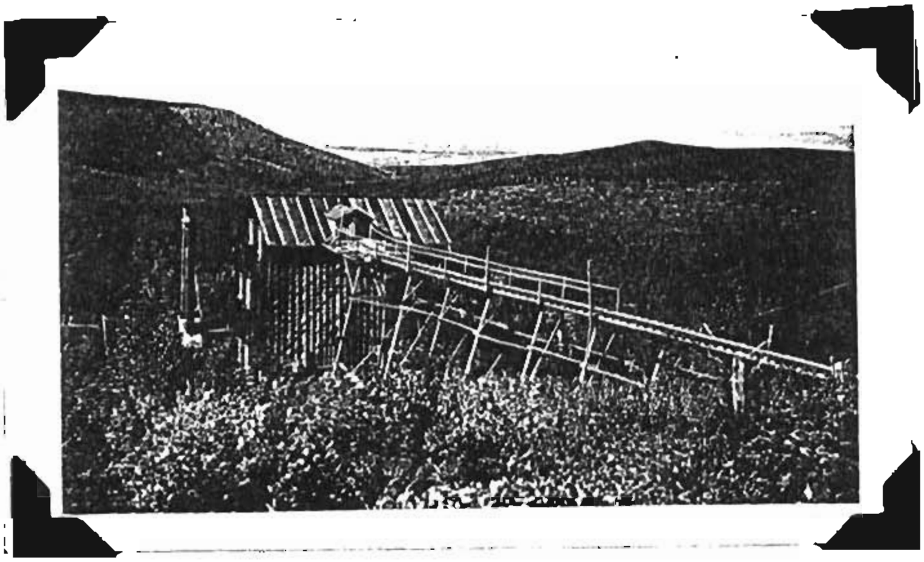
Ruby Creek placer tailing & Nixon Mill



Placer tailing Hidden Creek below Biddle Gulch

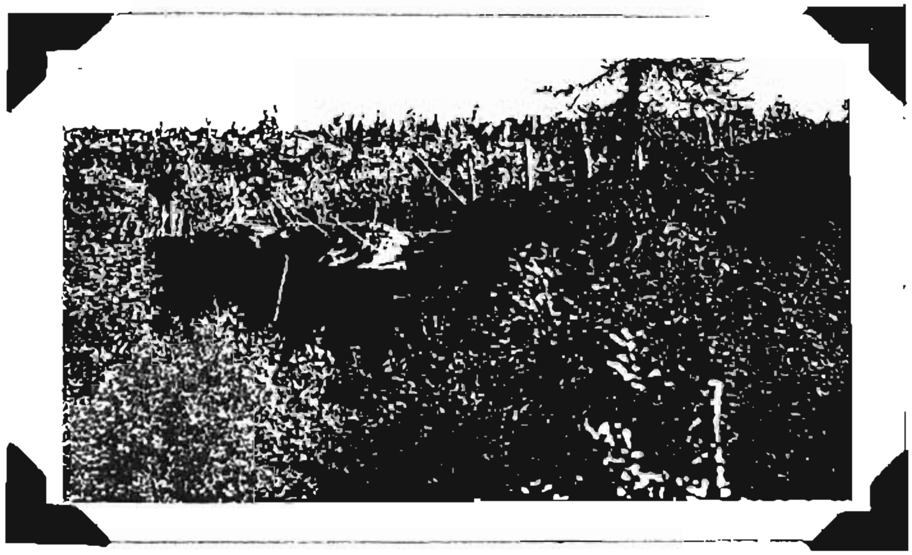


Down Holmes Gulch, Hidden Creek in distance



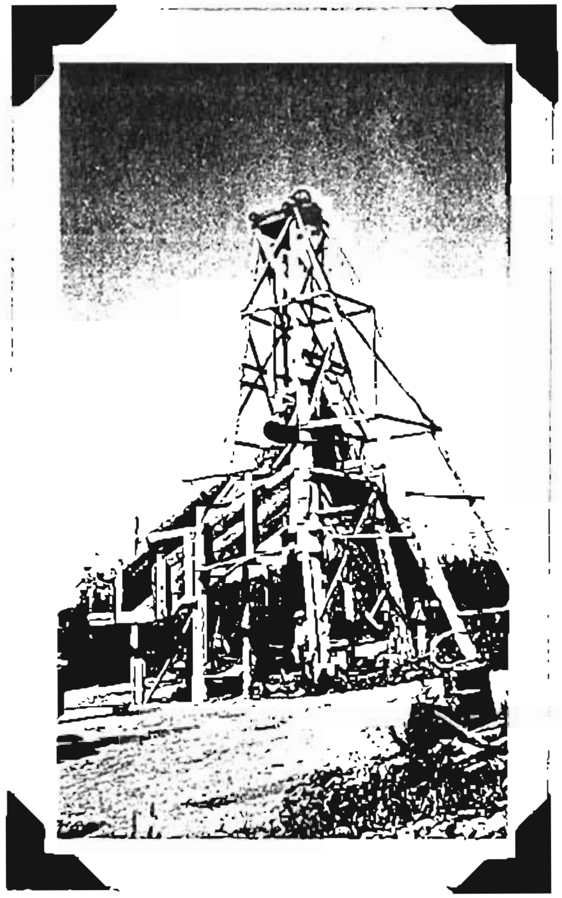
Nixon Mill, lower Ruby Creek & Nixon Fork in distance

Stamp batteries in Nixon Mill

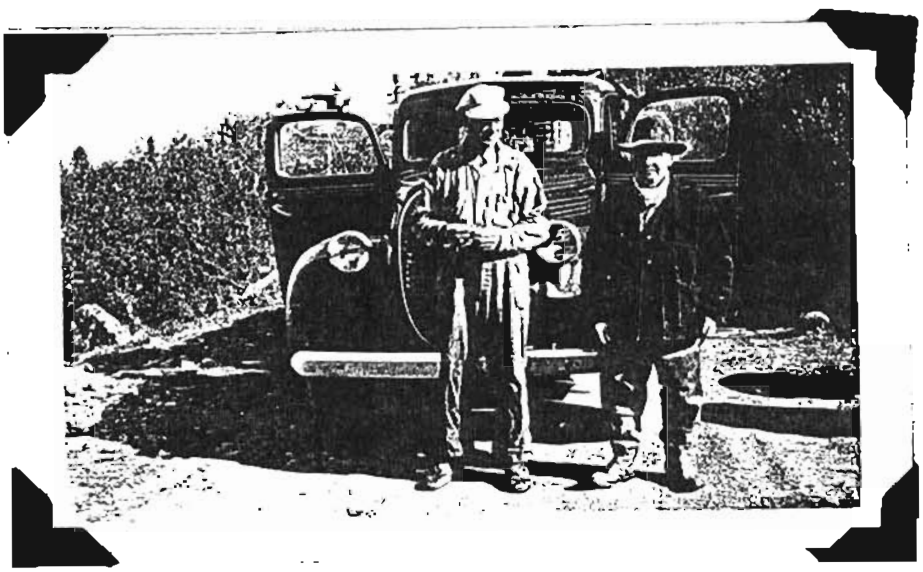


Mespelt tailing
Nixon Mill

Mespelt tailing
Nixon Mill



Headframe Mespelt Mines



B.A. "Bob" Stone & John Strand

Winans Roadhouse Medfra

December 23, 1948

ASSAY SCREEN TEST

Eagle Creek Prospect, Nixon Fork District "Ore" from Dump

Material: Quartz, Calcite, Siderite, Limestone and some Horneblend
Some limonite and pyrite.

Weight of Sample: 7,021.5 grams

Assay of Sample: 0.47 ounces gold per ton or $16.45 per ton.

Screen size	Weight Grams	Percent	Assay $
10	5,036	71.9	8.75
14	344	4.9	11.20
20	354	5.1	9.10
28	268	3.8	16.10
35	201	2.9	15.05
48	168	2.4	10.50
-48	631	9.0	22.05

Panning shows the gold is free; a small amount of sulphides is present, less than 5%.

May 2, 1952

EXCERPTS FROM PRELIMINARY REPORT

NIXON FORK MINING DISTRICT, ALASKA, by

Bruce I. Thomas, Associate Mining Engineer

SUMMARY

Approximately 149 feet of adit and 42 feet of shaft expose a mineralized zone about 27 inches in width at the Eagle Creek gold-lode prospect. Samples taken across the exposed face in the adit, by an engineer of the Territorial Department of Mines, average $60.83 a ton in gold. The underground workings have not proven the strike length of the mineralized body.

The geology of the Eagle Creek gold-lode prospect is similar to the geology in the Jumbo Peak area of the Nixon Fork District. In the Jumbo Peak area mineralized zones occurring along the contact between limestone and monzonite are classed as contact metamorphic and hypothermal replacement deposits. These deposits are composed of high grade, irregular shaped, discontinuous ore bodies of limited length. Irrespective of their size and form they have been mined at a profit on a small scale for several years. The Eagle Creek gold-lode prospect is a contact metamorphic deposit and further development work should prove that it too can be mined profitably on a small scale.

Preliminary examination and testing indicate the mineralized zone to contain "free milling" gold. A good recovery should be ob-

tained by amalgamation methods.

Lode and placer mining have been confined to the immediate vicinity of Jumbo Peak in the Nixon Fork District. The discovery of the Eagle Creek gold-lode prospect discloses the presence of a gold bearing zone approximately six miles from this center of mining activity. It is very likely that prospecting will reveal the presence of other gold occurrences that are of equal distance or farther from this locality.

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Detailed geologic studies and well planned exploration and development programs should reveal the presence of commercial ore bodies in existing lode mines of the district. Known placer deposits are worthy of exploration with a view of expanding known paystreaks. Bulldozers, diesel pumps and other modern machinery used by the Alaska placer miner have never been introduced into this district; it is entirely likely that their introduction would be the dominant profit factor.

INTRODUCTION

During August 1948 Bruce I. Thomas, Associate Mining Engineer, Territorial Department of Mines, made a preliminary examination of a lode-gold prospect at Eagle Creek in the Nixon Fork District, Alaska (Figure 1.) This property is the result of a recent discovery and the examination was conducted as part of the Territorial Department of Mines program of giving technical assistance to prospectors and small-mine operators in Alaska.

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The Eagle Creek gold-lode prospect is located at the head of Eagle Creek which is located in the southwest corner of the area and is approximately 8 miles northwest of Medfra. (Figure 2). A crude tractor trail connects the prospect with the truck road at a point approximately one mile north of Medfra. This trail is well defined and easily traverseable on foot throughout the entire length; about 3½ miles follow along the old Nenana-McGrath winter road. A truck road could be constructed along this route by staying along the hill slopes and on the ridges.

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A small radio station is located at Eagle Creek and daily communication is maintained with commercial stations at McGrath. This is the only operating radio station in the district at the present time.

Supplies and machinery are shipped from the states by ocean steamer to Bethel thence up the Kuskokwim River by boat and barge to Medfra. The cost of freight, including insurance, handling charges and wharfage, on general merchandise shipped from Seattle via this route to Medfra is approximately $120.00 a ton. Air freight from Fairbanks to Medfra is 10¢ a pound and passenger fare is $35.00 per person. A special air freight rate of 7¢ a pound on large shipments from Anchorage to Medfra can be obtained. Diesel oil and gasoline cost about 19½¢ and 25¢ a gallon, respectively, at Bethel.

The Nixon Fork District is located in the Mt. McKinley Precinct and Recording District. The recording office is located at McGrath, which is approximately 30 miles west of Medfra.

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The mineralized areas at the head of Eagle Creek and in the vicinity of Jumbo Peak are covered with 5 to 6 feet of overburden. Thorough prospecting requires the excavation of many trenches and pits in these sections.

The climate is subarctic and is characterized by long cold winters and relatively short warm summers. Winter temperatures are ofttimes -60° to -70° F. and the summer temperatures are as high as 85° to 95° F. The precipitation in this region appears to be slightly more than elsewhere in the adjacent regions. During the rainy season there is sufficient water for both large and small placer mining operations but during the dry season placer mining practically stops entirely. There is sufficient water at Eagle Creek for continuous operation of a small mill, 35 to 50 tons capacity, both summer and winter. This mill could be constructed at the head of the creek within 800 feet of the mineralized zone.

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Placer mining on a small scale predeeded the discovery of the lode-gold prospect at the head of Eagle Creek. Mining was done by hand methods in the early 1920s. The presence of placer gold stimulated the search for its bedrock source as was the case in the Jumbo Peak area. It was not until 1941, however, that the presence of lode gold deposits attracted any attention in this section. A small amount of develðpment work has been done in recent years.

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It is estimated that the placer gold production in the Eagle Creek area has amounted to but a few thousand dollars. There has been no gold production from the lode deposits in the area.

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Eagle Creek Area

Placer claims at the head of Eagle Creek are owned by B. A. "Bob" Stone, Medfra, and J. E. Dunn, McGrath.

Four lode claims, approximately 1,500 feet long by 600 feet wide, the Eagle Head, Big Bertha, Mistake and Damfine are owned by B. A. "Bob" Stone, Medfra, and J. G. Bayless, Fairbanks. These claims cover the Eagle Creek gold-lode prospect.

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GENERAL GEOLOGY

The country rock in the vicinity of the mining and prospecting areas consists of limestone, sandstone and shale. Two main intrusive masses of quartz monzonite appear to have invaded the sedimentary rocks of the areas namely in the vicinity of Jumbo Peak and Eagle Creek to the southwest. In these two localities limestone is the predominant sedimentary rock. Mineralization occurs in crystalline limestone near the contact of the quartz monzonite. The intrusive mass at Jumbo Peak is roughly elliptical in shape; and is about five miles in length and two miles in width; at Eagle Creek only a very small portion of the intrusive mass has been outlined. The intrusive masses in both localities are probably the roof pendants of a large granitic batholith that have been exposed by erosion.

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The gold-bearing mineralized zone at the Eagle Creek prospect is approximately 90 feet from the quartz monzonite. Free gold occurs with a small amount of pyrite, limonite, siderite, calcite, and some quartz. No copper carbonate or copper sulphide minerals have been identified. Garnet, epidote, actinolite, chlorite and sericite are also found in the mineralized zone. The contact line here, as elsewhere in the district, has been modified by cross faulting. The abundance or iron oxides and iron carbonates indicate that the processes of oxidation were active in the mineralized zone. The high temperature minerals garnet, epidote and tremolite are characteristic contact metamorphic minerals and here serve to classify this deposit. No detailed studies have been made to verify the classification and no attempt has been made to trace out the succession in which the minerals have developed in the ore zone. Such studies would serve to definitely establish the type of deposit. The limestone along the contact has been altered by the quartz monzonite intrusion producing various silicious phases which grade outward from the igneous mass into pure white crystalline limestone. (Figure 3).

SAMPLING AND ASSAYS

Two channel samples 4" wide and 3" deep were cut across the true width of the mineralized zone in the face of the adit. The entire samples were retained for assay.

Weighted value and tabulated results are shown in Table I.

Grab samples were taken from material extracted from a small trench at the bottom of the shaft and a large stock pile estimated to contain 20 tons of ore. The results of assays are listed in Table II.

TABLE I.

Sample No.	Ounces Per Ton		Value Per Ton	Width of Zone
	Gold	Silver		
Stone 103	2.96	Trace	$103.60	25"
Stone 104	0.72	Trace	25.20	30"

$$\begin{array}{rcrcr} 25'' & \times & 103.60 & = & 2590.00 \\ 30'' & \times & 25.20 & = & 756.00 \\ \hline 55'' & & & & 3346.00 \end{array}$$

$$\frac{3346.00}{55} = \$\ 60.83$$

TABLE II

Sample No.	Ounces Per Ton		Value Per Ton	Sample Location
	Gold	Silver		
Stone 101	1.20	Trace	$42.00	From dump near collar of shaft
Stone 102	0.34	Trace	11.90	Dump near small trench
Stone 106	0.47		11.45	Large stock pile

All assays were made by A. E. Glover, Assayer Territorial Department of Mines Assay Office, College, Alaska.

The present exposures do not permit estimate of ore reserves.

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The principal development work at Eagle Creek consists of 149 feet of adit and 42 feet of shaft. The general direction of the adit is north; it advances toward the downward projection of the shaft. The entrance is at the contact between quartz monzonite and limestone. The contact zone is followed for approximately 30 feet. The ground is loose and the adit is well timbered for this distance. At this point the adit swings 22° east into altered limestone; from here it is untimbered and stays in limestone throughout the remaining distance, 119 feet, to the face. One large water course and four faults are cross cut before the mineralized zone is encountered at the face. (Figure 3).

The shaft is reported to be 42 feet deep and to follow the mineralized zone throughout the entire depth. It was sunk at the site of the original discovery. At the present time the shaft is iced up and only a portion of the upper 15 feet is open to permit partial inspection of the walls.

The adit was driven with the intention and sole purpose of cutting into ore encountered at the bottom of the shaft.

Several small surface trenches have been dug near the site of the original discovery. Some ore has been recovered from float encountered in the overburden and near bedrock.

EQUIPMENT

Eagle Creek

Equipment at Eagle Creek gold-lode prospects consists of: 1 small gasoline powered 2-stage portable compressor, 1 small jack hammer, air hose, assorted blacksmith tools, picks, shovels, wheelbarrow and various small hand tools. There is a limited amount of air pipe and no mine rails or mine car.

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The characteristic of the lode deposits in the district has made it necessary to restrict mining operations to a limited basis. The limited size of the ore bodies has made it necessary to keep exploration and development well in advance of ore extraction to permit continuous operation on a limited scale. The near surface ore bodies have proven, in the past, to be the richest. The mantle of overburden dovering the mineralized areas has made it necessary to do considerable surface trenching in order to locate mineralized zones. Trenching has always been conducted by hand methods. Bulldozers would expedite and lessen the cost of surface prospecting. Surface exploration should prove the existence of more ore bodies in both the Jumbo Peak and Eagle Creek areas.

The most favorable areas in the district in which to prospect are along the contact between quartz monzonite and limestone. It is suggested that preference when prospecting for lode or placer be given to localities containing these rocks.

Carbonate rocks such as limestone are most affected by intrusions of magma and have proven to be most favorable host rocks for the formation of metaliferous deposits. Mineralization usually follows closely along the contact between the limestone and igneous rock, however ore bodies are often formed in the limestone several hundred feet away from the contact. Faults that extend outward and upward from the intrusion serve as channelways that conduct mineral-bearing solutions far from the intrusive mass.

Various contact metamorphic effects are produced from magmas of differing composition. The most favorable igneous rocks for the formation or ore deposits of this type common to this district are quartz monzonite, granodiorite, and quartz diorite. Contact metamorphic deposits are seldom developed from highly silicic rocks such as granit and seldom with basid rocks and never with ultra basic rocks.

Roof pendants and apophysis are good localities for the concentration of ore bodies and such areas are worthy of the prospectors and miners strictest attention.

The most outstanding feature of contact-metamorphic and hydrothermal replacement deposits is the fact that ore bodies when encountered are usually high grade but of limited extent. Without numerable working faces the mining of such deposits is not profitable unless conducted upon a limited scale.

ASSAY SCREEN TEST

Eagle Creek Prospect, Nixon Fork District "Ore" from Dump

Material: Quartz, Calcite, Siderite, Limestone and some Horneblend. Some limonite and pyrite.

Weight of Sample: 7,021.5 grams

Assay of Sample: 0.47 ounces gold per ton or $16.45 per ton.

Screen size	Weight Grams	Percent	Assay $
10	5,036	71.9	8.75
14	344	4.9	11.20
20	354	5.1	9.10
28	268	3.8	16.10
35	201	2.9	15.05

(Cont.)

Screen size	Weight Grams	Percent	Assay $
48	168	2.4	10.50
48	631	9.0	22.05

Panning shows the gold is free; a small amount of sulphides is present, less than 5%.

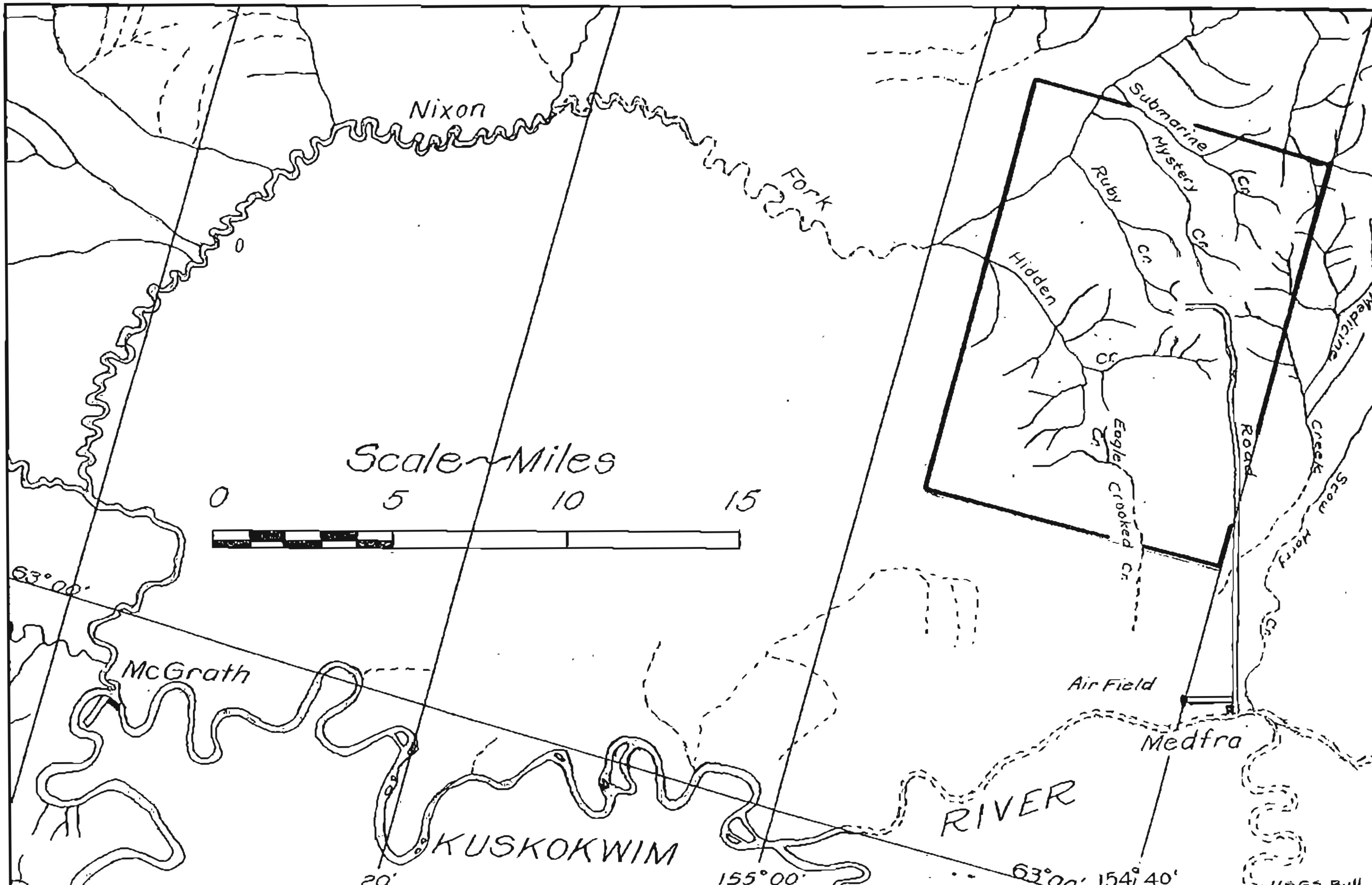


Fig. I NIXON FORK DISTRICT, ALASKA

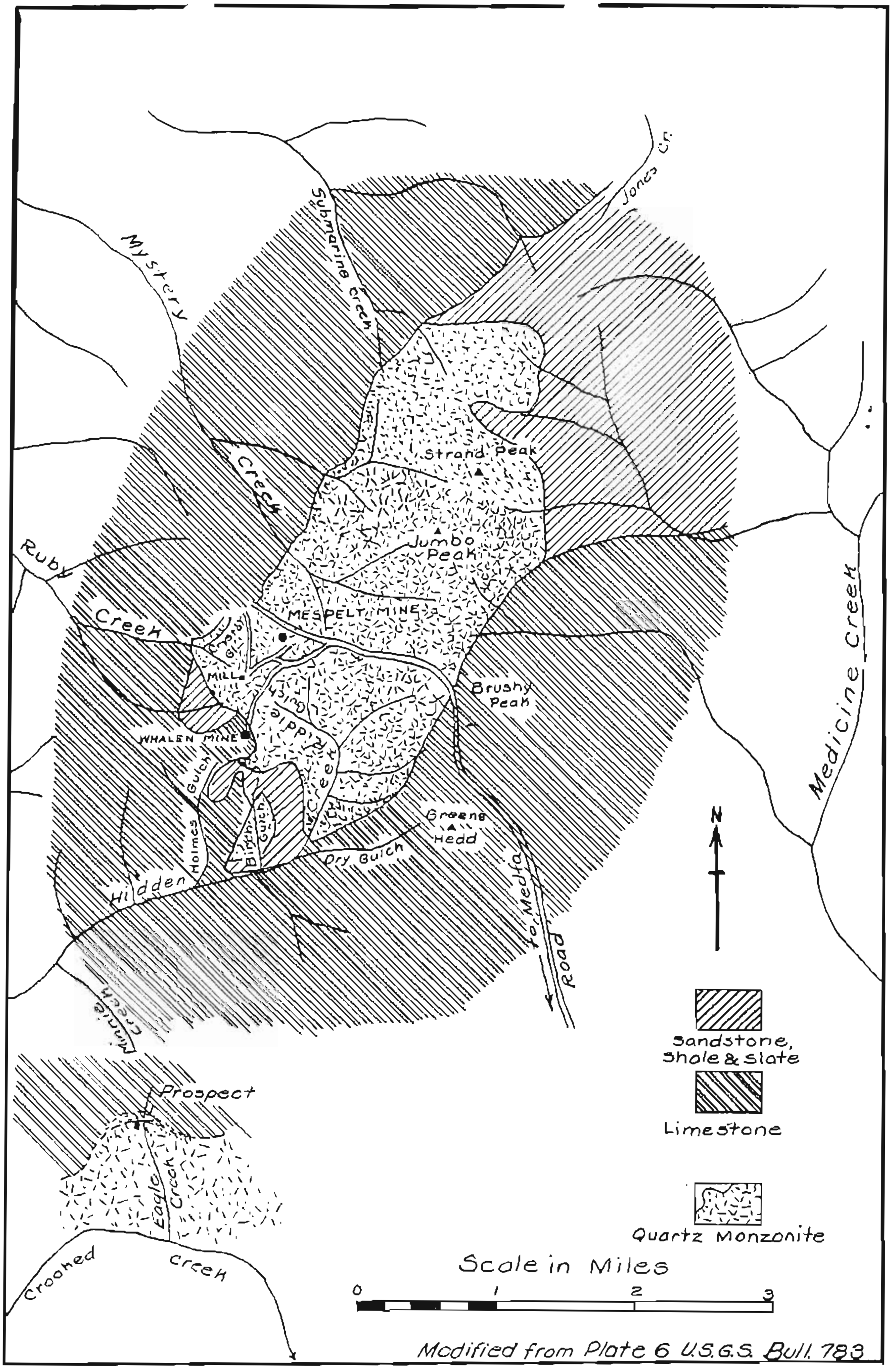


Fig. 2 SKETCH OF GEOLOGY & DRAINAGE

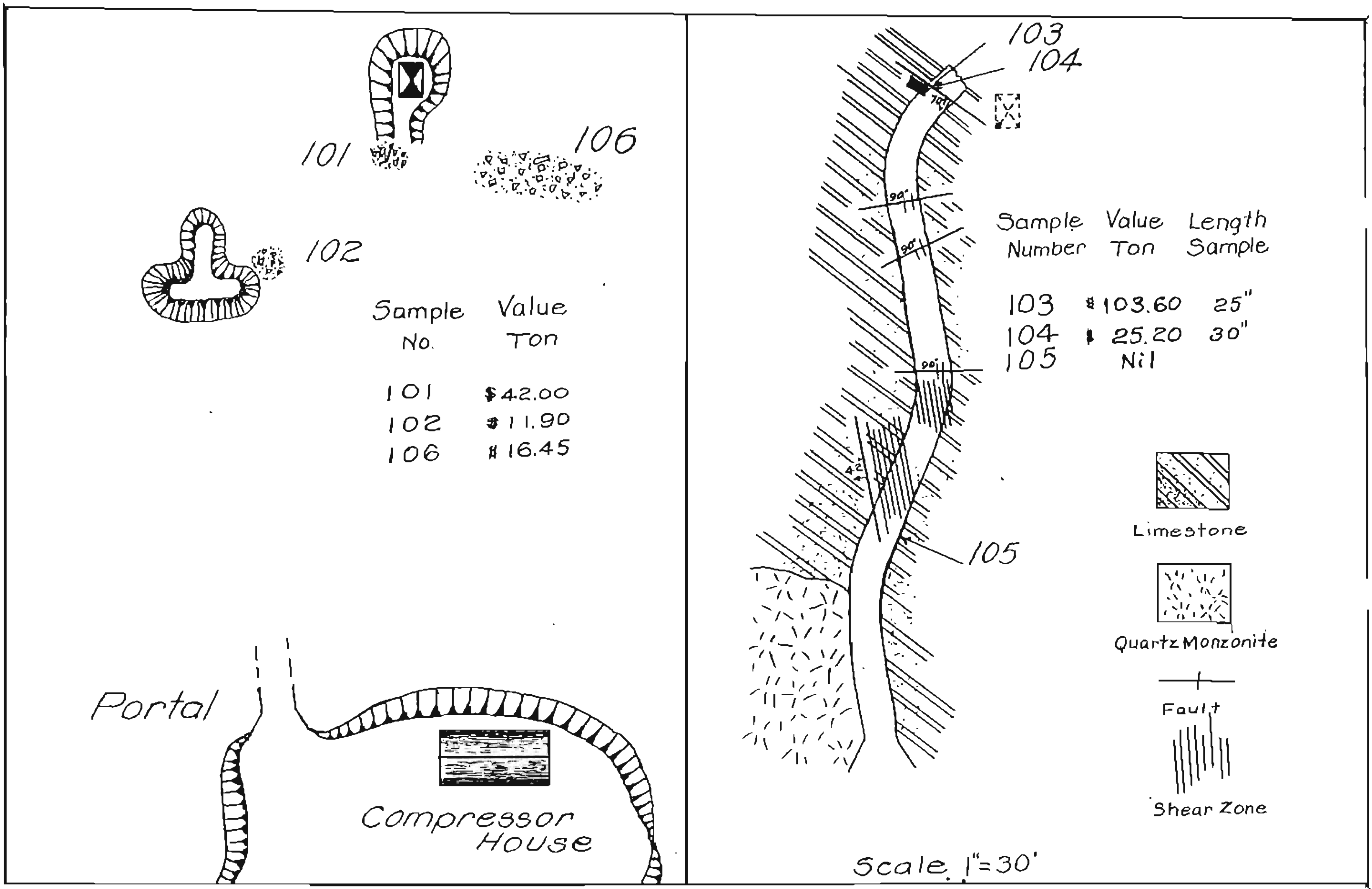
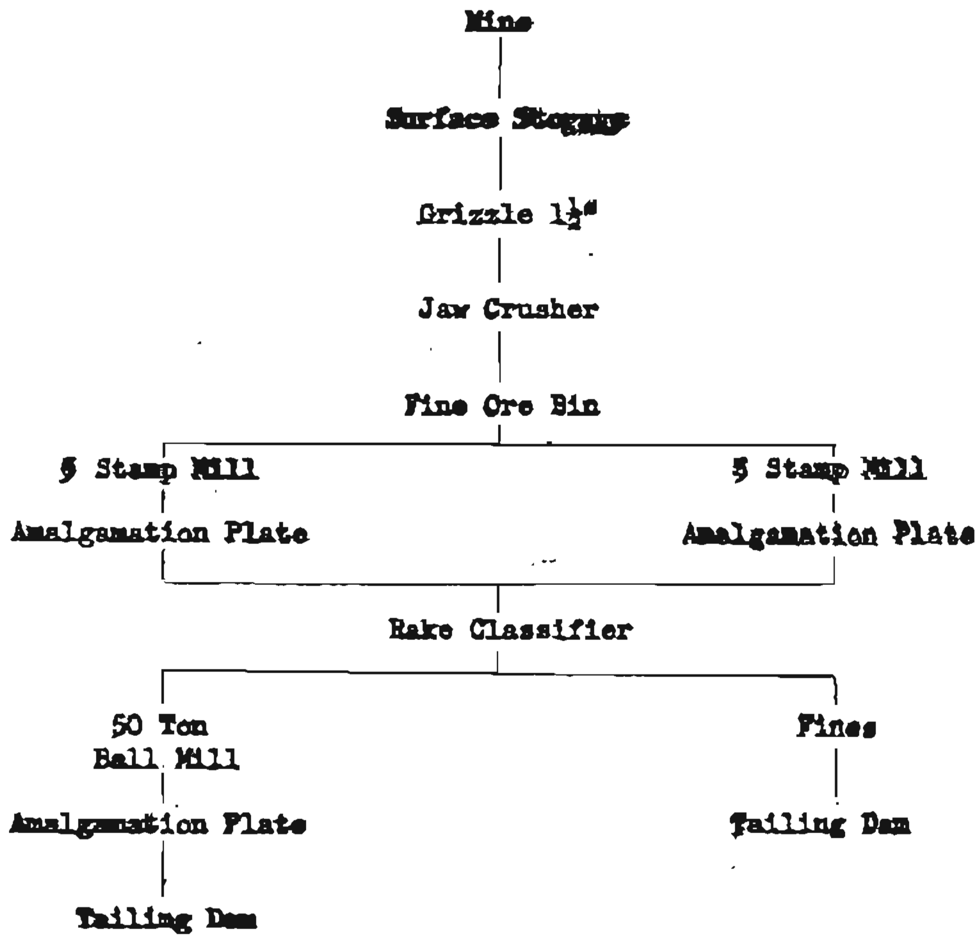


Fig.3 EAGLE CREEK PROSPECT ~ SURFACE & UNDERGROUND WORKS



Power: 2- 70 HP Boilers

1- 125 HP Steam Engine

Fig 4 FLOW SHEET NIXON MILL