IC 9113

Bureau of Mines Report of Investigations/1987

Evaluation of Selected Lode Gold Deposits in the Chugach National Forest, Alaska

By Robert B. Hoekzema, Steven A. Fechner, and Joseph M. Kurtak

UNITED STATES DEPARTMENT OF THE INTERIOR

Information Circular 9113

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UNITED STATES DEPARTMENT OF THE INTERIOR
Donald Paul Hodel, Secretary

BUREAU OF MINES
Robert C. Horton, Director

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environment and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

Library of Congress Cataloging-in-Publication Data

Hoekzema, Robert B.
Evaluation of selected lode gold deposits in the Chugach National Forest, Alaska.

(Information circular; 9113)

Bibliography: p 56

Supt. of Docs. no.: I 28.27:

1. Gold ores—Alaska—Chugach National Forest. 2. Chugach National Forest (Alaska) I. Fechner, Steven A. II. Kurtak, Joseph M. III. Title. IV. Series: Information circular (United States. Bureau of Mines) ; 9113.

TN295.U4 [TN423.A7] 622 s [553.4'1'097983] 86-600229

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UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

d/yr	day per year	oz/st	ounce per short ton
ft	foot	oz/yd^3	ounce per cubic yard
ft^3	cubic foot	pct	percent
ft^3/s	cubic foot per second	ppm	part per million
hp	horsepower	st	short ton
in	inch	st/d	short ton per day
lb	pound	st/h	short ton per hour
m.y.	million years	yd^3	cubic yard
oz	ounce	yr	year

EVALUATION OF SELECTED LODE GOLD DEPOSITS IN THE CHUGACH NATIONAL FOREST, ALASKA

By Robert B. Hoekzema,[1] Steven A. Fechner,[2] and Joseph M. Kurtak[2]

ABSTRACT

This Bureau of Mines report describes the history, characteristics, distribution, and mineral development potential of 21 lode gold deposits in or near the Chugach National Forest (CNF), AK. It includes findings from a 4-yr (1979 to 1982) mineral evaluation of the CNF conducted by the Bureau and the U.S. Geological Survey (USGS). This evaluation, undertaken to provide the U.S. Forest Service with mineral resource data for use in making decisions on land use, included site-specific mapping and sampling of more than 200 lode gold deposits. The data presented here were compiled from the findings of this 4-yr evaluation and from existing literature.

Fourteen of the 21 lode gold deposits described in this report contain a combined identified resource of 117,750 short tons (st) averaging 0.55 oz/st Au and 0.2 oz/st Ag. Two mineralized felsic dikes in the Summit Lake-Palmer Creek area contain a combined identified resource of 18 million st grading 0.02 oz/st Au and 0.16 oz/st Ag. Identified resources were not determined for the remaining five deposits because of a lack of information.

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INTRODUCTION

A mineral resource investigation of the CNF was conducted by an interagency team of Bureau of Mines and USGS researchers. The purpose of the study was to provide U.S. Forest Service planners with mineral resource information they could use in making decisions on land-use classification. This investigation, initiated under the Roadless Area Review and Evaluation II (RARE II) program, started in 1979 and was completed in 1982. The USGS compiled and evaluated data on the regional geology, geochemistry, and geophysics. The Bureau compiled and evaluated data on mines, prospects, mineral occurrences, and areas of mineralization, to identify mineral resources and determine mineral development potential. The data collected by the Bureau are summarized in a previous Bureau report (*18*).[3] A joint USGS-Bureau summary report, published by the USGS as MF-1645A (*35*) describes the geology, geophysics, geochemistry, and mineral resource potential of the study area. Other Bureau reports discuss the critical and strategic mineral development potential (*15*); placer (*12, 14, 18*), manganese (*25*), and molybdenum deposits (*16*); and results of sampling (*17, 28*) in the CNF.

This report discusses the distribution, characteristics, and mineral development potential of 21 significant lode gold deposits in the CNF. It also presents recommendations concerning additional examinations and other predevelopment work considered necessary either to realize the potential of these deposits or to provide the basis for assessments that cannot be made with existing information. However, such additional work is not currently planned by the Bureau.

Lode gold deposits were identified in the CNF in the late 1800's, on the Kenai Peninsula, where about 26,700 oz Au was produced from lode mines in the Moose Pass, Summit Lake, and Girdwood areas between 1899 and the mid-1950's. Additional production came from the Cliff Mine (51,740 oz) near Valdez and the Granite Mine (24,440 oz) on Port Wells.

LOCATION AND LAND STATUS

The CNF is located in south-central Alaska and is approximately 5.9 million acres in size (fig. 1). Federal, State, city, and private land holdings (including Native regional corporation selections) are present within the area studied. The CNF boundaries and land status are shown on figure 2. Much of the CNF is open to mineral entry; however, Bureau of Land Management (BLM) and/or U.S. Forest Service land status records should be consulted prior to staking claims. The BLM mining claim report dated October 19, 1984 (*68*), indicated 2,420 placer and 667 lode claims in the CNF.

PREVIOUS STUDIES

Published work on CNF mineral resources includes reports by the USGS, private companies, the State of Alaska, universities, and the Bureau of Mines.

[3]Italic numbers in parentheses refer to items in the list of references preceding the appendix.

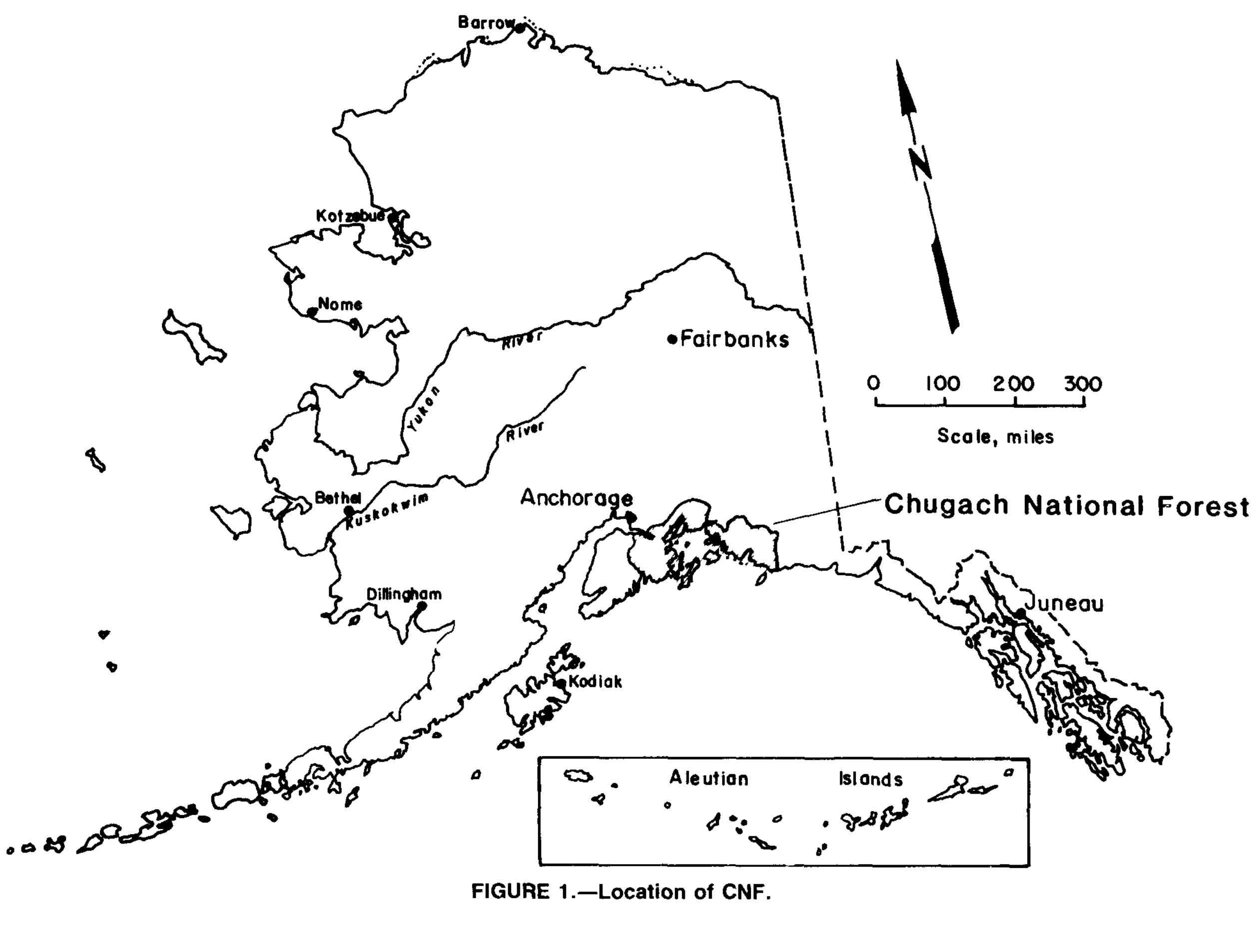


FIGURE 1.—Location of CNF.

FIGURE 2.—Land status within CNF.

Non-Bureau Studies

The earliest reports describing the geology and mineralization of the CNF were published by the USGS (*3, 27*). Brooks (*5*) and Johnson(*24*) described the lode and placer deposits of the Valdez and adjacent area. Johnson (*21*) discussed the Port Wells lode gold district. Grant and Higgins (*13*); Johnson (*20, 22*); Martin, Johnson, and Grant (*26*); Capps (*9*); Park (*37*); and Tuck (*65*) discussed the geology and mineral resources on the Kenai Peninsula and nearby areas. Barry (*2*) summarized the history of mining on the Kenai Peninsula. Tysdal (*66-67*) published maps showing lode deposits and occurrences and the geology of the Seward and Blying Sound quadrangles. Case and others (*10-11*) published reports interpreting the gravity and aeromagnetic characteristics of the Seward and Blying Sound quadrangles. Budnik (*6*), Mitchell (*29*), and Pickthorn (*38*) completed theses concerning the geologic history and mineralization of the Valdez Group of metamorphosed sedimentary rocks. Recently, a combined USGS-Bureau report (*35*) summarizing the mineral resources and geology was published.

Bureau Studies

The Bureau collected site-specific information on mineral deposits for use in determining the mineral development potential of mineral deposits in the CNF. This information was incorporated in reports to the U.S. Forest Service for use in land-use planning.

The Bureau's contribution to the mineral evaluation of the CNF consisted of a literature search and site-specific field work which included mapping and sampling of mines, prospects, mineral occurrences, and mineralized areas; estimating identified resources; and determining the mineral development potential of the examined deposits. The Bureau's field work focused on metallic mineralization, such as lode gold, copper, and placer gold deposits.

Pre-field office work and the literature search were initiated in 1979. Data compilation on mineralization, production, and mining history included the review of commonly available literature, exploration or mining company files, files at the Technical Data Section of the USGS at Menlo Park, CA, records of the Assay Office of the U.S. Mint at Seattle, WA, and the Bureau's Minerals Availability System (MAS) files in Juneau, AK. Requests for information were made to individuals familiar with the CNF area or having historical data. All data were reviewed and evaluated to obtain a historical overview.

Field work in 1979 was mostly of a regional reconnaissance nature, with more detailed followup work at mineralized areas in 1980, 1981, and 1982. Field work included locating the prospects, mapping accessible workings, and identifying and evaluating the extent of mineralization and its geologic setting. In addition to locating mines and prospects, the Bureau investigated geochemically anomalous areas to determine if unreported zones of mineralization were present. Standard sampling procedures included the collection of continuous-chip and random-chip samples. Samples were quantitatively analyzed using fire assay (FA) and atomic absorption (AA) techniques. Sample data in this report are listed in parts per million (ppm) for AA analyses and ounces per short ton (oz/st)for FA analyses. Bureau data were used to prepare a report concerning the feasibility of gold and copper mining (*52*) and to estimate the development potential of mineral deposits in the CNF (*18*).

The scope of the mineral assessment was not uniform across the study area. Differences were due to the amount of historical data available, access, topography, surface cover, and the Alaska National Interest Land Conservation Act's (ANILCA) revision of the study area (CNF) boundaries. The evaluation was most complete in areas of historic mining activity and weakest in the eastern part of the study area, especially for the College Fiord and Rude-Copper River ANILCA additions to the CNF made in December 1980. The new additions included mostly areas of relatively inaccessible, largely ice-covered land with few reported mineral occurrences. Mineral resources in these areas may have been bypassed or overlooked at the time of peak exploration activity because of ice cover, location, and access problems.

Identified resource estimates were made for deposits for which sufficient data were available. These estimates were made by multiplying the known strike length of mineralization by the average thickness by the known depth or by one-half the strike length (for unknown depth), to determine volume in cubic feet. The volume was divided by a tonnage factor ranging from 11.7 to 12, depending upon estimated specific gravity, to determine the tonnage, in short tons, of resource present.

Jansons, Hoekzema, Kurtak, and Fechner (*18*) have described all known mines, prospects, and occurrences in the CNF and rated the mineral development potential of each using one of four levels: "high," "moderate," "low," or "unknown." These ratings were based on an evaluation of mineral values, distribution of mineralization, and geologic and geochemical factors.

A deposit of "high" mineral development potential would, by definition, have high values and probable continuity of mineralization. A deposit of "moderate" mineral development potential might have high metal contents, but the mineralization might be distributed discontinuously in and along structures. A deposit with "low" mineral development potential would contain uneconomic values and/or show little evidence of continuity of mineralization. For example, quartz veins averaging less than 1 ft thick with grades below 0.1 oz/st Au would rank as low. Similarly, mineralized narrow fractures a few inches wide and/or extending laterally up to several tens of feet, with no evidence of continuity, would rank as low. Table 1 summarizes the mineral development potential ratings for the deposits described in this report.

Table 1.—Summary of mineral development potential ratings for selected deposits in and near CNF

Deposit[1]	*Rating*
Cliff Mine	High.
Ramsay-Rutherford Mine	High(?)
Gold King Mine	Unknown
Donohue prospect	High.
Granite Mine	Moderate.
Mineral King Mine	Do.
Culross Mine	Do.
Portage Mine	Do.
Primrose Mine	High
Crown Point Mine	Do.
Skeen-Lechner and Falls Creek Mines	Do.
East Point Mine	Do.
Gilpatrick Mine	Do.
Summit Vein prospect	Do.
Heaston-Oracle Mine	Do.
Hirshey-Lucky Strike Mine	Do.
Nearhouse Mine	Moderate.
Gilpatrick dike	Low to moderate
Palmer Creek dike	Do.
Monarch Mine	High
Jewel Mine	Do.

[1]In order of discussion in this report.

ACKNOWLEDGMENTS

The authors thank Dr. Miles Silberman, USGS geologist, Denver, CO, who assisted Bureau personnel in collecting samples and data and provided information necessary for understanding the genesis of mineral deposits within the CNF. Thanks are also expressed to Philip Burna, habitat biologist with the Alaska Department of Fish and Game, Anchorage, AK, and Peter Paranese, chief of operations, Alaska Division of Parks and Recreation, Anchorage, who supplied permits for sampling within the CNF and adjacent areas. Numerous miners cooperated with the Bureau by supplying considerable information and advice concerning lode gold deposits. Thanks are especially expressed to the following: Edward Ellis, Crescent Creek miner; George Zimmer, Milo Flothe, and Robert Kelley, Quartz Creek miners; Patrick Bogan, East Point Mine owner; and Marvin Self, Mills Creek miner.

GEOLOGIC SETTING

The majority of the CNF is underlain by tightly folded and extensively faulted metamorphic rocks of the Cretaceous Valdez and Eocene Orca Groups. Younger Tertiary sedimentary rocks are exposed in the easternmost portion of the CNF, and Tertiary plutons are scattered throughout. The general geology of the CNF is shown in figure 3.

VALDEZ GROUP

The Valdez Group crops out in the western and northern portions of the CNF as an arcuate-shape band of rocks consisting mostly of a slightly metamorphosed, steeply dipping, marine clastic (flysch) sequence. Turbidites composed of well indurated, rhythmically interbedded sandstone, siltstone, and argillite with minor pebble conglomerate are the most common Valdez Group lithologies. Interbedded sediments, tuffs, and pillow basalts occur north and east of Cordova; and basalt sills and sheeted dikes, gabbro, and serpentinized dunite occur on the Resurrection Peninsula. An excellent summary of the petrography of the Valdez Group sandstones is given by Dumoulin in Winkler, Miller, Hoekzema, and Dumoulin (*69*). Most Valdez Group sandstone is compositionally a graywacke (i.e., the percentage of lithic grains is greater than the percentage of feldspar grains) but is not texturally a graywacke (matrix less than 15 pct). Lithic clasts are predominantly volcanic in origin and of andesitic composition (*31, 70*). Most of the lode gold production came from deposits hosted by Valdez Group rocks. Plafker, Jones, and Pessagno (*39*) speculate that these rocks accreted to the southern Alaska mainland during the late Cretaceous and early Tertiary periods.

ORCA GROUP

The Orca Group crops out in the central portion of the CNF as an arcuate-shape band of rocks located immediately east and south of the contact fault that separates it from the Valdez Group (fig. 3). These rocks are similar in appearance and composition to those of the Valdez Group but tend to contain a greater proportion of mafic volcanics. The Orca Group hosts a few widely scattered lode gold deposits, but only two of these have produced, and their production was small. Plafker, Jones and Pessagno (*39*) speculate that these rocks accreted to the southern Alaska mainland during the Paleogene.

YOUNGER TERTIARY ROCKS

Tertiary rocks, younger than the Orca Group, are present at Kayak Island and areas east of the Ragged Mountains. Younger rocks consist of unmetamorphosed siltstones, claystones, shales, sandstones, and basalt. The younger Tertiary strata include the Yakataga, Redwood, Poul Creek, Tokun, Kulthieth, and Stillwater Formations, plus undivided sedimentary and volcanic rocks that were deposited on the Orca Group and its associated plutonic rocks during periods of marine transgression and regression (*39*).

The younger Tertiary sedimentary rocks contain known deposits of subbituminous coal, oil, and gas. However, recent exploration has not located commercial deposits of hydrocarbons.

TERTIARY PLUTONS

Tertiary plutonic rocks were emplaced during two main and one minor intrusive episodes (*35*). On the basis of potassium argon dating, major episodes occurred at 50 to 53 m.y. and 34 to 36 m.y. (*35*). Older plutons are generally medium-grained biotite and/or hornblende-biotite granite. Younger plutons, which occur in the western portion of the CNF along the Orca-Valdez Group contact, have multiple phases and vary widely in composition from granite to gabbro. A minor episode of plutonism is represented by a 6-m.y.-old dacitic plug at the southern tip of Kayak Island (*35*).

Lode gold mineralization in Valdez Group rocks is associated spatially with Tertiary plutons at many locations in the CNF. Streams draining these areas characteristically contain gold-bearing gravels, and one, Crow Creek, near Girdwood, has been a significant placer gold producer.

STRUCTURE

Valdez Group rocks are complexly folded and faulted. Some coarser grained rocks contain well-preserved sedimentary features, but most outcrops display a well-developed foliation. Regionally, an obvious parallelism of fold axes and faults exists. At least two stages of deformation are recognized.

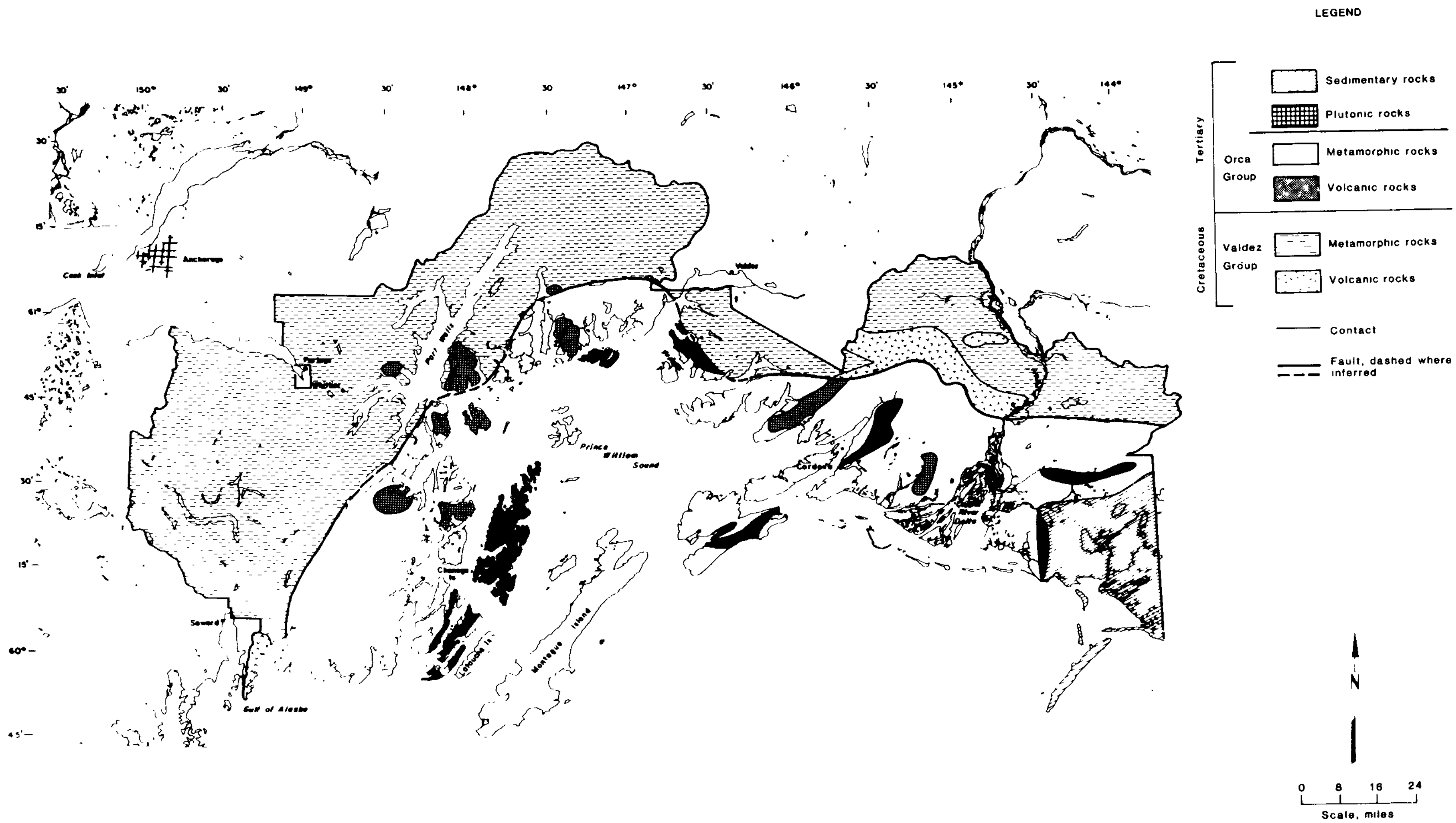


FIGURE 3.—Geologic map of CNF.

Folding

At least two generations of folding have been documented within the Valdez Group. One set (type 1) consists of regional-scale (isoclinal ?) folding with axial planes striking north to northeast and dipping steeply west and axes plunging moderately to the north (fig. 4). The second set (type 2) has axial planes similar in attitude to those of the larger scale folds, but axes plunge steeply and are often spatially related to the large regional reverse diagonal-slip faults. Mineralized quartz veins locally show evidence of occupying the crests of relatively large folds. Mitchell (*29*) discusses folding in the Hope area in some detail.

Faulting

Two prominent sets of faults occur in Valdez Group rocks. Regionally, the most apparent occur as relatively widely spaced (several miles) north-northeast striking, steeply west dipping longitudinal faults having reverse vertical and right lateral horizontal components of movement (diagonal-slip faults). The east side of each fault has apparently moved down and south relative to the west side. Examples include the Contact, Port Wells, and Placer River faults. Related (?) but much more closely spaced (hundreds of feet) parallel faults and shear zones are recognized throughout the area. Faults in the second set are older and occur as relatively closely spaced (50 to 500 ft) west-to-northwest striking, steeply dipping transverse faults. These typically have left-lateral horizontal displacements of a few feet and vertical displacements of similar magnitude. Quartz veins develop along one or both of the fault directions in most areas. Mineralized quartz veins are usually emplaced along transverse fractures that are typically offset by the northeast striking set of diagonal-slip faults.

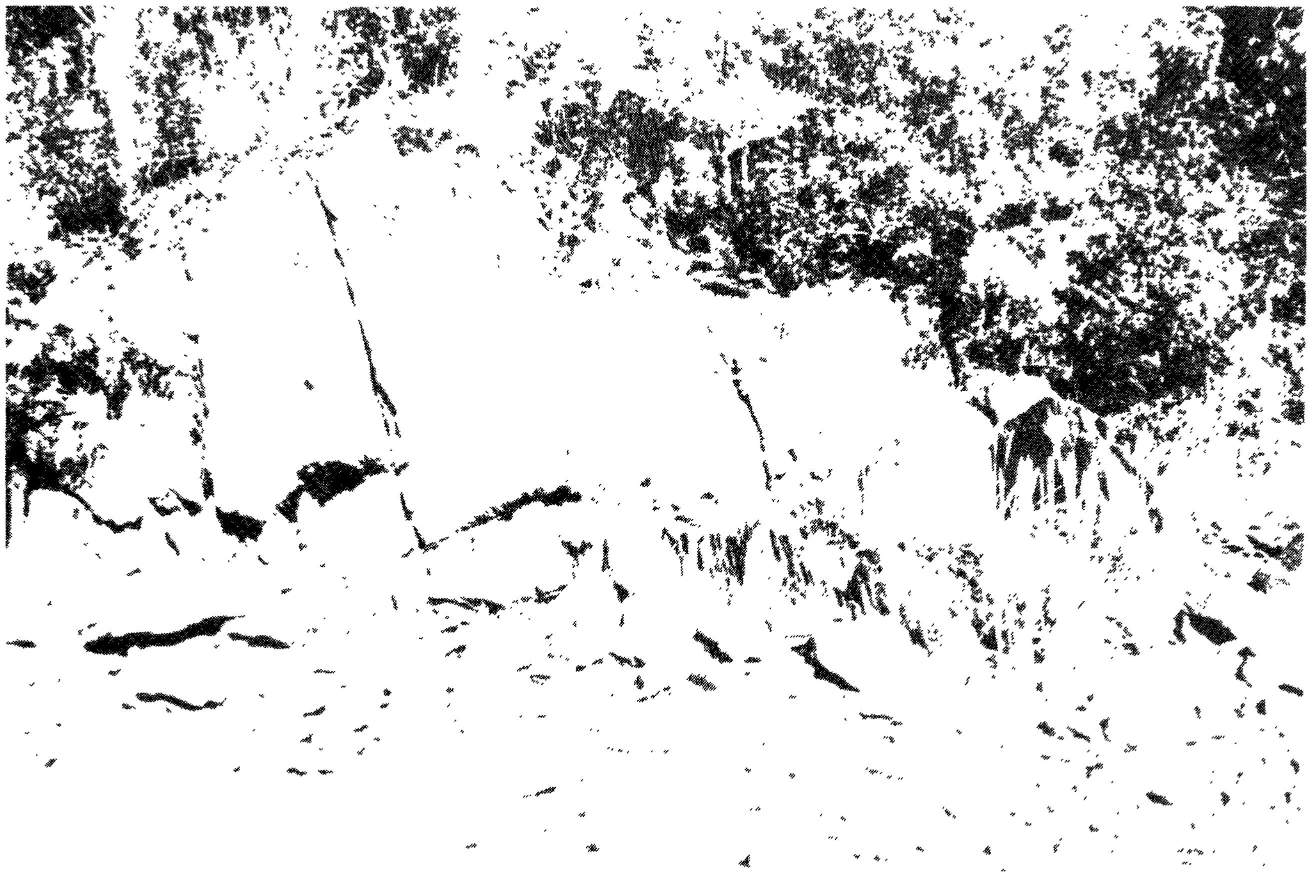


FIGURE 4.—Type 1 fold in Valdez Group flysch on north side of Turnagain Arm near Bird Point.

MINERALIZATION

Gold occurs in epigenetic quartz-carbonate veins emplaced along shear zones and fractures in Valdez Group flysch deposits. The veins have been classified into six categories, based upon the amount of sulfides present and their spatial relationship to intrusives: (1) quartz-carbonate veins with variable (less than 3 pct to greater than 10 pct) sulfide content associated with small- to medium-size granitic stocks, (2) quartz-carbonate veins with low sulfide content spatially associated with, but not in contact with, felsic dikes, (3) quartz-carbonate veins with low sulfide content recementing fractured felsic dikes, (4) quartz-carbonate veins with low sulfide content not associated with felsic dikes or granitic stocks, (5) quartz-carbonate veins with high sulfide content not associated with felsic dikes or granitic stocks, and (6) quartz-carbonate veins hosted by Orca Group volcanics and flysch.

Mineralized quartz-carbonate veins are generally vuggy and banded in appearance (fig. 5). Bands consist of a bluish translucent quartz interlayered with thin carbonaceous-appearing bands and a mixture of milky quartz and buff-colored carbonate. Accessory sulfides typically include arsenopyrite, pyrite, galena, sphalerite, chalcopyrite, stibnite, and molybdenite. Galena, arsenopyrite, and to a lesser extent, sphalerite, generally accompany high gold values in most veins. Gold occurs as disseminated grains often associated with bluish quartz, as intergrowths in sulfides such as galena and arsenopyrite, and as smears along fracture surfaces. The gold is distributed throughout the vein, but typically occurs in and along the sheared margins. Trace amounts of gold may extend into the wall rock, especially where shearing is prevalent.

The origin of gold-quartz veins is a controversial subject among geologists working in the CNF and similar graywacke-slate terranes. Numerous investigators have attempted to relate such deposits to orogenic-related magmatic events; others argue that they can be related to metamorphic processes. Boyle (*4*) summarizes the controversy and concludes the following:

> It is sufficient to state here that some gold-quartz veins and other auriferous deposits exhibit a spatial relationship to intrusive granitic bodies in orogenic zones throughout the world; other gold-quartz veins and gold-bearing deposits show no such relationship. Nearly all types of epigenetic gold deposits, however, are restricted to rocks that exhibit a low to moderate degree of metamorphism (greenschist to amphibolite facies). One does not find epigenetic gold deposits in rocks that do not show the effects of considerable recrystallization and alteration such as regional propylitization. From this fact the logical conclusion seems to follow that epigenetic gold deposits in the vicinity of intrusive granitic rocks is not fortuitous. The reason for this, however, may not be that the granitic bodies provided the gold, but that these bodies are simply one in a series of products of intense metamorphism. These bodies also include the gold deposits, the gold being derived from piles of sedimentary and volcanic rocks and concentrated as a result of granitization and later metamorphic processes that continued long after the emplacement, crystallization, and consolidation of batholiths, stocks and dykes of granite, granodiorite, etc.

Mitchell, Silberman, and O'Neill (*30*) have studied fluid inclusions from gold-quartz veins in the Hope area and suggest that silica, carbon, sulfur, and metals contained in unstable volcanic detrital grains within Valdez Group sediments were dissolved by circulating meteoric water and subsequently deposited in auriferous quartz veins along open, predominantly northwest-oriented structures. These

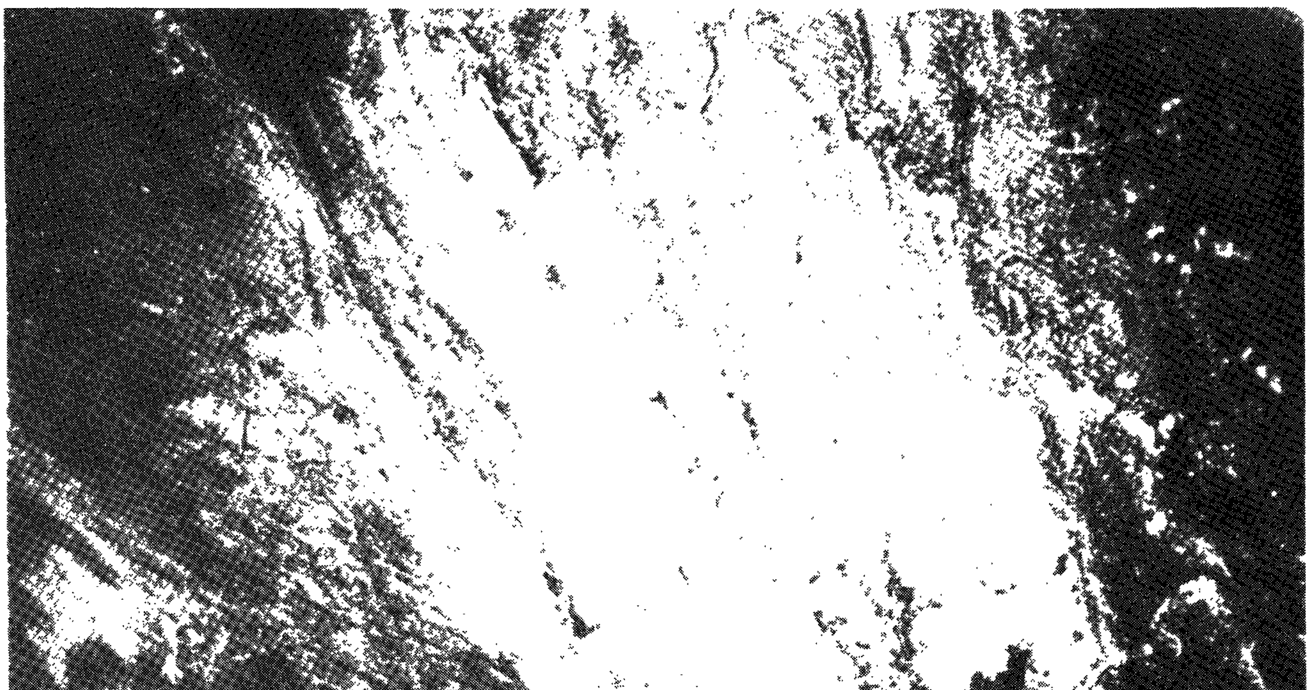


FIGURE 5.—Hirshey-Lucky Strike vein exposed in 3,400-ft level.

deposits are not spatially associated with granitic plutons, and it has not been determined whether veins located elsewhere in the CNF near and in granitic intrusives, such as those at the Granite Mine, can be similarly explained. Mineralized veins at the Granite Mine and elsewhere fill fractures in the granite, indicating that they postdate the intrusions, but additional work will be needed to fully understand their genesis.

Recent work by the USGS suggests that gold-quartz veins are regionally restricted to areas of medium greenschist facies metamorphic rocks.

Characteristics of each deposit type are summarized in the following sections.

Quartz-Carbonate Veins With Variable Sulfide Content Associated With Small- to Medium-Sized Granitic Stocks

Structure: Veins crosscut regional structure at variable angles and are peripheral to locally crosscutting intrusive contacts. Generally moderately to steeply dipping. Occur along shear zones and fissures.

Size: Small to medium. 6 to 48 in thick, 200 to 600 ft or more long, 150 to 500 ft depth. Identified resources usually range from 5,000 to 10,000 st with a maximum of 50,000 st.

Grade: Medium to high. Recorded production grades range from 0.5 to 0.9 oz/st Au.

Associated sulfides: Sulfide content ranges from less than 1 to 30 pct and includes arsenopyrite, galena, sphalerite, pyrite, pyrrhotite, chalcopyrite, and locally molybdenite and stibnite.

Metal associations: Gold is fine-grained (less than 0.01 in). Occurs as disseminated grains and in sulfides. Associated with high galena contents.

Production history: CNF deposits have produced over 33,000 oz Au and 4,150 oz Ag, mostly from the Granite Mine (24,440 oz Au, 2,500 oz Ag).

Examples: Granite, Portage, Monarch, Jewel, and Mineral King Mines.

Quartz-Carbonate Veins With Low Sulfide Content Spatially Associated But Not in Contact With Felsic Dikes

Structure: Steeply dipping veins crosscutting regional structure at 30° to 60°. Occur in fissures and along joint surfaces. Consistently cut off by faults and often sheared.

Size: Small. Less than 3 to 48 in thick, 50 to 500 ft long, 50 to 300 ft depth. Identified resources usually range from 500 to 1,500 st with a maximum of 15,000 st.

Grade: High. Recorded production grades range from 0.7 to 0.9 oz/st Au. Veins sampled commonly averaged 1 to 2 oz/st Au.

Associated sulfides: Arsenopyrite, galena, sphalerite, pyrite and chalcopyrite.

Metal associations: Gold occurs in carbonaceous ribbons adjacent to or surrounded by galena, smeared along fracture surfaces and in vugs. Gold is reported to be plus 60 mesh in producing mines, but is seldom coarser than plus 6 mesh.

Production history: CNF deposits have produced in excess of 8,100 oz Au and 5,000 oz Ag from the Summit Lake-Hope area. Minor production reported from similar veins in the Golden area on the east side of Port Wells.

Examples: Hirshey-Lucky Strike, Nearhouse, and Oracle Mines.

Quartz-Carbonate Veins With Low Sulfide Content Recementing Fractured Felsic Dikes

Structure: Dikes dip near vertically and strike subparallel to regional structure.

Size: Large. 2 to 18 ft thick, 1,000 ft to several miles long, unknown depth. Identified resources estimated at 14 million st, maximum.

Grade: Low. Less than 0.1 oz/st Au. Quartz veins may be locally high grade.

Associated sulfides: Arsenopyrite, pyrite, chalcopyrite, galena, sphalerite, and locally, stibnite and pyrrhotite. Arsenopyrite occurs in the dike rock.

Metal associations: Gold is associated with quartz-containing galena and sphalerite.

Production history: Gilpatrick Mine is the only producer, with 3,545 oz Au, 1,099 oz Ag total. However, production occurred from high-grade quartz veins crosscutting or adjacent to the Gilpatrick dike, not the dike itself.

Examples: Gilpatrick Mine.

Quartz-Carbonate Veins With Low Sulfide Content Not Spatially Associated With Dikes or Stocks

Structure: Veins usually crosscut regional structure at 50° to 90°. Dips are 45° to vertical. Occur along shear zones offset by faults.

Size: Small. 6 to 48 in thick, 100 to 450 ft long, 50 to 250 ft deep. Identified resources of 3,000 to 5,000 st with maximum of 14,000 st.

Grade: High. Production grades of 0.4 to 4.92 oz/st Au reported. Veins sampled averaged from 0.4 to 1.6 oz/st Au.

Associated sulfides: Arsenopyrite, galena, chalcopyrite, pyrite, and sphalerite.

Metal associations: The gold appears to be disseminated along vein contacts and along fractures. Gold is mostly fine with particles greater than 0.01 in. rare.

Production history: Several properties had significant production totaling about 9,500 oz Au and 1,950 oz Ag. The Crown Point Mine was the largest producer, with 3,145 oz Au and 639 oz Ag.

Examples: Crown Point, East Point, Skeen-Lechner, Falls Creek, Ramsay-Rutherford, and Gold King Mines.

Quartz-Carbonate Veins With a High Sulfide Content Not Spatially Associated With Dikes or Stocks

Structure: Veins generally parallel regional structure and have steep dips. Occur along well-defined shear zones. Mineralization occurs in pods.

Size: Small. 3 to 36 in thick, 25 to 250 ft long, up to 150 ft deep. Usually, more than one vein occurs together. Identified resources: 750 to 1,050 st/vein. Maximum identified resources of 7,000 st/vein

Grade: High. Production grades of Primrose Mine reported to be about 5 oz/st Au. Samples collected from veins in the area contained from a trace to 3 oz/st Au.

Associated sulfides: Arsenopyrite, galena, sphalerite, pyrite, chalcopyrite, and pyrrhotite.

Metal associations: Ribbon structure, locally well-defined. Gold is fine-grained and appears to occur in carbonaceous bands.

Production history: Production exceeding 52,000 oz Au and 8,300 oz Ag. Mostly from the Cliff Mine (51,740 oz Au, 8,153 oz Ag). Primrose has recorded production of 659 oz Au, 138 oz Ag. Reported production exceeded 4,000 oz Au.

Examples: Cliff and Primrose Mines and Donohue prospect.

Quartz-Carbonate Veins Hosted by Orca Group Volcanics

Structure: Steeply dipping quartz carbonate veins hosted by Orca Group volcanics.

Size: Small. 1 in to 3 ft thick, 410 ft long, up to 200 ft deep. Maximum identified resources of 15,000 st.

Grade: Medium. Samples collected suggest grades do not exceed 0.5 oz/st Au.

Associated sulfides: Galena, chalcopyrite, pyrrhotite, arsenopyrite, and sphalerite.

Metal associations: Gold appears to be associated with galena and sphalerite-rich material.

Production history: Minor production—62 oz Au, 53 oz Ag.

Example: Culross Mine.

MINING HISTORY, PRODUCTION, AND RESERVES

The earliest recorded attempts to identify mineral resources in the CNF were made by Russian explorers in the mid-1800's. Peter Doroshin, a mining engineer sent by the Russian-American Co., reported finding widespread auriferous gravels along the Kenai River system in 1848, but was apparently unsuccessful in locating commercial quantities of gold (*2*). Lode gold was explored for and mined on a small scale in the Valdez, Port Wells, Kenai Peninsula, and Girdwood areas of the CNF beginning in the late 1890's. Exploration also occurred at McKinley Lake near Cordova, but only minor gold was produced. Production from the main lode gold deposits in the CNF is summarized in table 2. Total documented lode gold production is about 132,000 oz.

Table 2.—Production from main lode gold deposits in and near CNF

Mine	Location shown in figure—	Recorded production,[1] oz Au	Recorded production,[1] oz Ag
Cliff	7	51,740	8.153
Granite	12	24,440	2,492
Hirshey-Lucky Strike	23	6,094	4,699
Ramsay-Rutherford	7	5,375	1,194
Monarch and Jewel	29	4,933	996
Primrose	18	[2]659	138
Gilpatrick	23	3,545	1,099
Crown Point	18	3,145	639
Mineral King	12	2,783	626
Gold King	6	1,997	187
Skeen-Lechner and Falls Creek	18	1,851	520
East Point	18	1,725	479
Heaston-Oracle	23	1,274	256
Portage Bay	12	490	60
Nearhouse	23	102	3
Culross	12	62	53
Total[3]		[4]128,695	20,925

[1]From available records

[2]More than 4,000 oz Au according to Burnette (*7*)

[3]Totals include production from approximately 25 additional deposits

[4]See footnote 2; using Burnette's data for the Primrose Mine, total gold production would be more than 132,036 oz.

Gold deposits in the Valdez area occur to the north of and mostly outside the study area. The trend of the deposits extends into the CNF, west to and across Columbia Glacier, and east of the Cliff Mine along the Lowe and Tasnuna Rivers. Little interest was shown in lode gold mining in northern Prince William Sound until 1910, when the veins at the Cliff Mine, discovered in 1906 at Port Valdez, proved to be excellent producers. By 1911, 48 mines and prospects were located from Valdez Glacier to Columbia Glacier, a distance of about 26 miles.

Producing properties in the Port Wells area include the Granite, Mineral King, and Portage Bay Mines. With the exception of the Granite Mine, lode gold prospects consist of small, widely scattered, mineralized quartz and quartz-carbonate veins. The date of the first lode gold discovery in the Port Wells area is not known, but it is likely that this discovery had occurred by 1910.

On Culross Island, two lode gold deposits are present south of Culross Bay. Both deposits, the Culross Mine and the John Sells prospect, contain gold in quartz-filled fissures. Claims were first staked in 1907. By 1950, at least 895 ft of underground workings existed at the Culross Mine.

On the Kenai Peninsula, the possibility of gold-bearing veins was noted in the Summit Creek area in 1896 (*26*). Lode claims were located on Bear, Palmer, and Sawmill Creeks in 1898. Those located in the Falls Creek area were staked in 1905, and those near Slate and Summit Creeks were staked in 1906. The first notable (but sporadic) production in the Falls Creek area occurred in 1911. Over the years, gold production has come periodically from the same properties. The longest continuous lode gold production on the Kenai Peninsula came from the Hirshey-Lucky Strike veins

Table 3.—Identified resource estimates for deposits in and near CNF

Deposit	Location shown in figure—	Identified resource,[1] st	Grade, oz/st Au	Grade, oz/st Ag
QUARTZ VEIN DEPOSITS				
Cliff Mine	7	ND	ND	ND
Ramsay-Rutherford	7	ND	ND	ND
Gold King Mine	7	ND	ND	ND
Donohue prospect	7	2,500	0 42	0.1
Granite Mine:				
Ore	12	1,900	.78	[e].1
Tailings	12	30,000	.18	[e].02
Mineral King Mine	12	500	.012	[e].002
Culross Mine	12	9,800	16	.1
Portage Mine	12	10,000	.6	[e].1
Primrose Mine	18	1,300	1.42	.6
Crown Point Mine	18	50	2.0	5
		31,000	.37	1
Skeen-Lechner and Falls Creek Mines	18	10,000	.82	3
East Point Mine	18	3,700	2.35	.5
Gilpatrick Mine	23	2,000	.89	65
Summit Vein prospect	23	3,400	2.4	1.6
Heaston-Oracle Mine	23	ND	ND	ND
Hirshey-Lucky Strike Mine	23	2,100	1.25	.65
Nearhouse Mine	23	6,400	.2	3
Monarch Mine	30	ND	ND	ND
Jewel Mine	30	3,100	1.75	.75
Total		117,750	.55	.2
FELSIC DIKE DEPOSITS				
Gilpatrick Dike	23	14,000,000	0.02	0.2
Palmer Creek Dike	23	4,000,000	.03	.07
Total		18,000,000	.022	16

[e]Estimate based upon past production records. ND Not determined.

[1]Identified resources were calculated using the half-square technique (length of known mineralization × width × depth [equal to 1/2 the known length]) unless otherwise indicated in report.

on Palmer Creek. Other producers include the Primrose, Skeen-Lechner, East Point, Crown Point, Grant Lake, Gilpatrick, Heaston-Oracle, and Ronan and James Mines.

Auriferous veins were discovered in 1909 near Girdwood, at the headwaters of Crow Creek. Sporadic production occurred from 1926 to 1947. Remains of a small flotation mill are still present at the Monarch Mine site near Crow Pass.

In the McKinley Lake area, east of Cordova, most of the surface trenching and underground work had been completed by 1912 (*40*). Records show gold production there as 16 oz. Although gold-bearing quartz veins and stockworks are present, the gold distribution is erratic, sparse, and discontinuous.

The majority of the lode gold deposits in and near the CNF are small, as indicated by past production and identified resource estimates made as a part of this study (table 3). Fourteen deposits contain a total identified resource in excess of 117,750 st with a weighted-average grade of 0.55 oz/st Au and 0.2 oz/st Ag. On the Kenai Peninsula, two mineralized felsic dikes collectively contain an identified resource of 18 million st with a grade of 0.02 oz/st Au and 0.16 oz/st Ag.

MINE FEASIBILITY STUDY

The Bureau completed a preliminary mine feasibility study for a small hypothetical lode gold mine in the CNF in 1984 (*52*). The hypothesized ore body contained 50,000 st of gold ore and had a 4-ft mining width, which increased the extracted tonnage to 100,000 st of material. An estimated 70 pct of the gold could be recovered by simple gravity-separation techniques. The mine was assumed to operate 330 d/yr at 100 st/d and have a mine life of 3 yr. Pre-production costs and capital expenditures were estimated to be $3,630,700. Based upon these assumptions, an underground operation of this type could break even with an ore grade of 0.75 oz/st Au and a gold price of $305/oz.

Based upon information from this study, deposits similar in size to the Cliff and Granite Mines could be profitably mined under current economic conditions. Although no deposits in the CNF are known to contain 50,000 st of identified resources that are currently economically recoverable, the potential exists for locating a deposit of this size through detailed site-specific exploration.

LODE GOLD DEPOSITS

Jansons, Hoekzema, Kurtak, and Fechner (*18*) have summarized information concerning 273 known lode gold deposits in the CNF based upon Bureau and USGS RARE II studies. Because of their similarities and the relative insignificance of most of the deposits, only selected deposits having significant gold production (greater than 1,000 oz) and/or moderate to high mineral development potential are discussed by area in this report. Five areas containing recognized concentrations of lode gold deposits in the CNF are discussed: the (1) Valdez, (2) Port Wells, (3) Moose Pass, (4) Summit Lake-Palmer Creek and (5) Girdwood areas. The locations of these areas within the CNF are shown on figure 6.

VALDEZ AREA

Approximately 60 lode gold deposits have been identified in the Valdez area. Four of these deposits, the Cliff Mine, Ramsay-Rutherford Mine, Gold King Mine, and Donohue prospect are discussed in detail.

Cliff Mine

The Cliff Mine is at sea level on the north shore of Port Valdez east of Shoup Bay (fig. 7).

History and Production

The Cliff Mine was originally located and staked by H. E. Ellis in 1906 (*1*). The property was leased to the Cliff Mining Co. in 1909, which began development work immediately and installed a three-stamp mill in 1910 (*5*). A larger six-stamp mill was constructed to replace the three-stamp mill in 1911. Production occurred from 1910 to 1918. Dewatering of the lower mine levels began in 1920, but failed, and only assessment work was done between 1921 and 1932. A second dewatering effort was attempted in 1933, but it also failed (*54*). The mine was reopened in 1936. Milling began in 1937 (*56*) and continued through 1942. The mine closed in 1942 in response to Public Law 208 (which closed down mining operations not necessary for the war effort) and has never reopened. The buildings at the mine site were destroyed by tsunami waves resulting from the 1964 Good Friday earthquake. The claims were patented to H. E. Ellis in 1977. The Cliff Mine was the largest producing gold mine in the Prince William Sound area, with a recorded production of 51,740 oz Au and 8,153 oz Ag from 29,695 st of ore (table 4).

Operating Data

Workings reported in 1913 totaled 8,000 ft in length (22) on 10 levels at elevations ranging from 443 ft above to 332 ft below sea level. However, considerable development work has occurred since that time. Equipment used at the mine included a three-stamp mill, a six-stamp mill, amalgamation plates, six concentrating tables, and three boilers capable of generating 200 hp.

Geologic Setting

Country rock at the Cliff Mine is predominantly Valdez Group graywacke with interbedded slate. The general strike of the country rock is east-west, and dip is steep to the north.

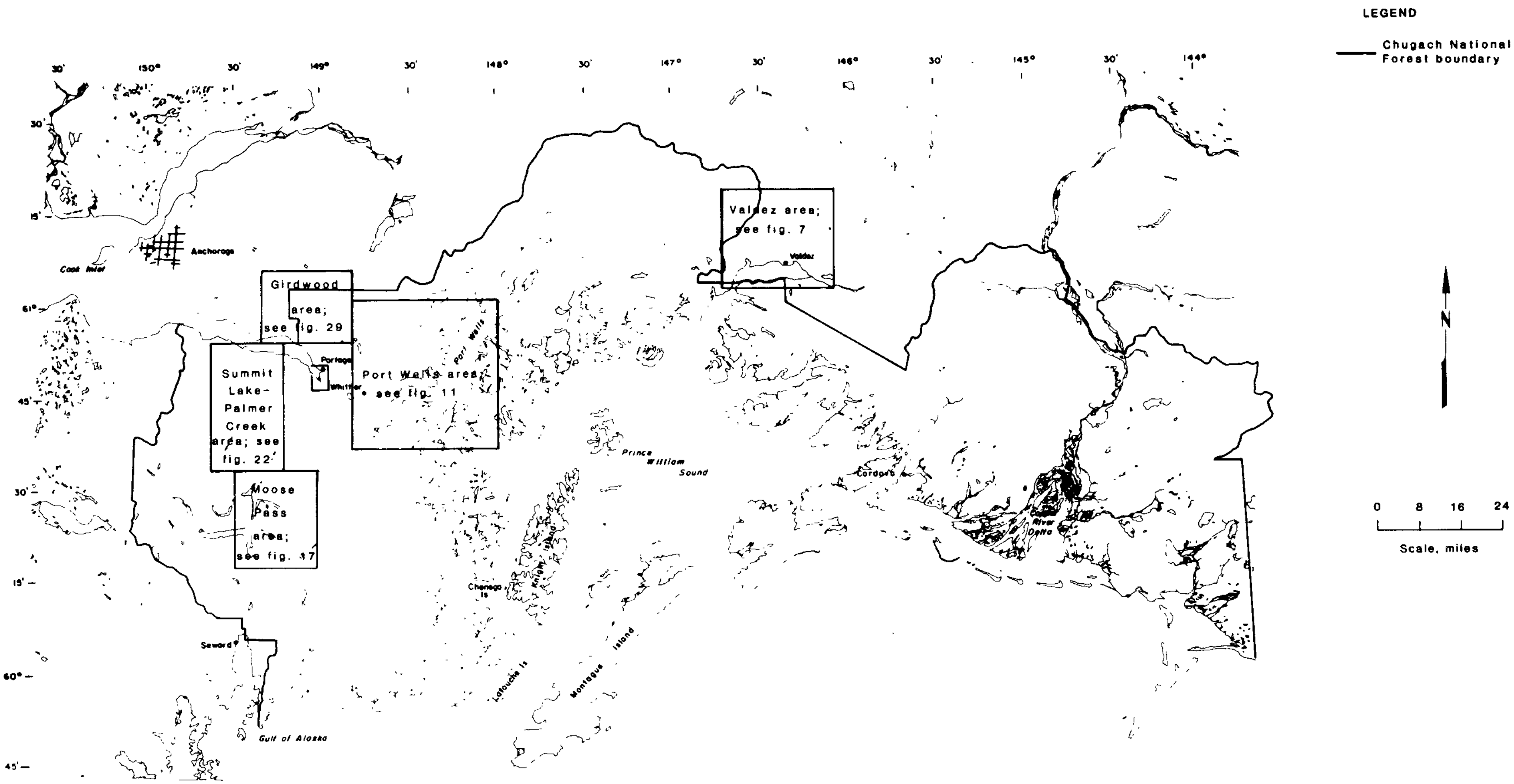


FIGURE 6.—Locations of areas in CNF with concentrations of lode gold deposits.

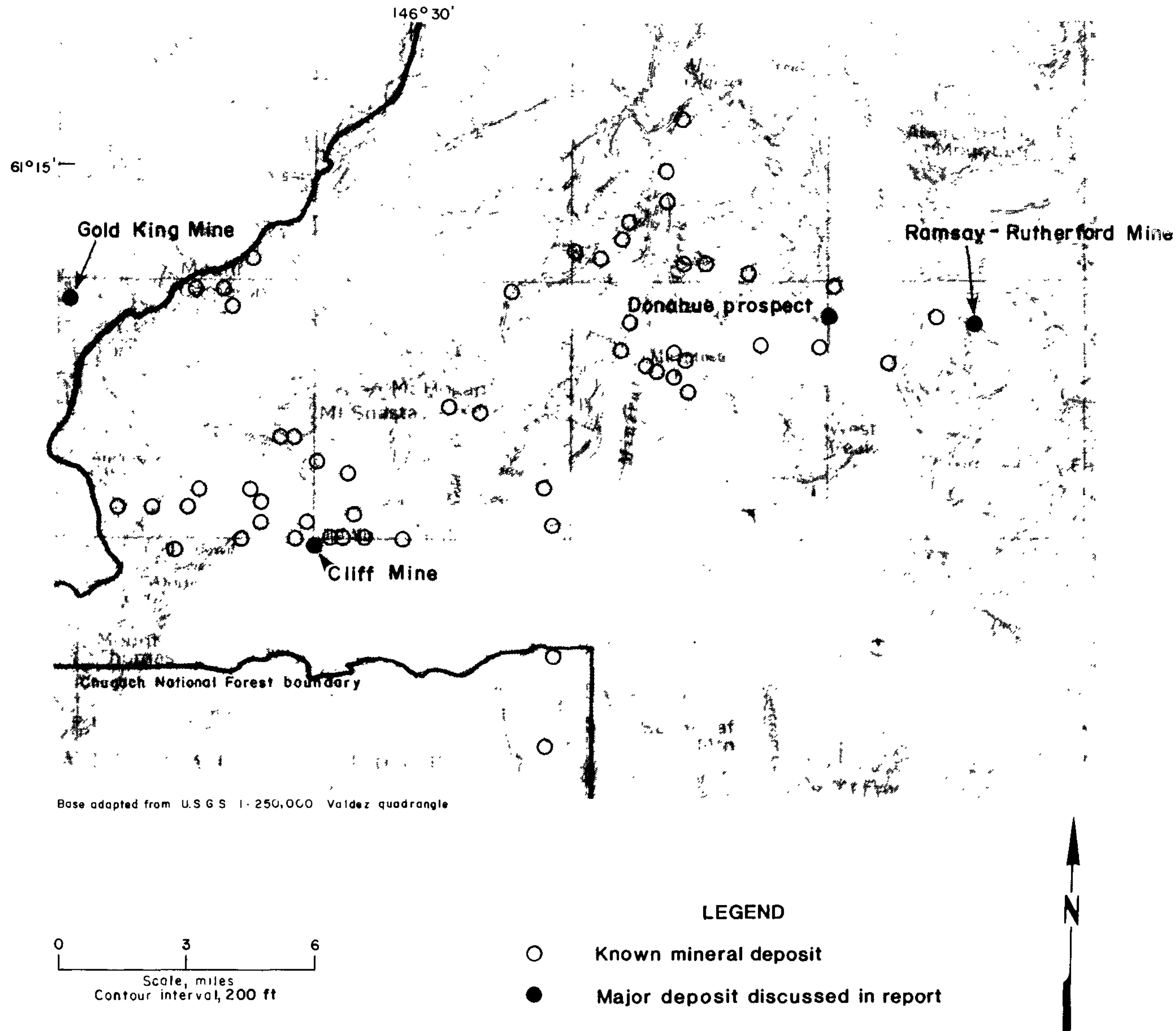


FIGURE 7.—Locations of important lode gold deposits in Valdez area.

Gold mineralization is present in a linked quartz vein system, which occurs in fissures. The fissures strike mostly from N30° to 40°W and dip from 65°E to 50°W. The veins dip more steeply below the 300-ft level of the mine. Johnson (*22*) reported that several persistent fissures in the mine fork, enclose large lenticular masses of country rock, and then reunite along strike without crossing one another. The quartz veins are persistent and well-defined in graywacke and dispersed in slate country rock. Fissures range from 6 in to 5 ft thick, and quartz veins within the fissures range from a fraction of an inch to 5 ft thick. Moffit (*33*) stated that horizontal displacement of the country rock (less than 6 ft) is present along the fissures. The quartz veins were mined for approximately 1,700 ft along strike, from Port Valdez to Shoup Bay (*33*).

The vein material consists of a bluish-white quartz with minor amounts of calcite, albite, chlorite, and a brownish weathering carbonate (*22*). Veins show rough banding or contain vugs that are lined with small quartz crystals. The banded ore reportedly contains the highest gold values.

Table 4.—Recorded gold-silver production from Cliff Mine

Year	Ore, st	Recovery, oz	
		Au	Ag
1910	4,440	10,745	913
1911	3,325	7,981	718
1912	4,676	11,242	2,394
1913	7,515	7,996	1,601
1914	2,198	2,339	468
1915	404	919	68
1916	441	1,183	81
1917	365	1,520	288
1918	100	226	40
1919-36	None	None	None
1937	[1]876	783	168
1938	500	833	175
1939	231	138	20
1940	864	677	145
1941	[2]2,560	3,459	713
1942	1,200	1,695	360
1943-48	None	None	None
1949	Cleanup	4	1
Total	[3]29,695	51,740	8,153

[1]Also mined: 462 st tailings.
[2]Also mined: 330 st tailings.
[3]Plus 792 st total tailings.

Metallic minerals include gold, arsenopyrite, pyrite, and galena, with sulfides comprising up to 5 pct of the ore (*22*). Pyrite and arsenopyrite are most abundant as impregnations of the graywacke country rock. Acicular crystals of arsenopyrite are present in the graywacke adjacent to the veins.

Gold is not distributed evenly in the quartz veins, but occurs in ore chutes (*33*). Moffit (*33*) reported that on the 550-ft level, gold was present in the quartz and scattered along the slickensided surfaces of the vein walls. Brooks (*5*) reported gold values in the gouge, which is present along the footwall of the veins. Gold is associated with galena and sphalerite, but not with pyrite.

Moffit (*33*) hypothesized on the emplacement of the quartz veins as follows:

> Vein quartz of more than one generation is present in the bedrock and in the ore-bearing vein system. The oldest was deposited in the foliation and joint planes of the schistose graywacke and is not a bearer of gold or other valuable metals. At a much later time quartz that makes up the veins was deposited. Some of the vein quartz of the ore bodies is cut by younger veins and it thus appears that the deposition of the vein quartz took place at different times or that if it was continuous, new sets of fissures were opened from time to time.

Bureau Work

Bureau investigators visited the mine in 1979, 1980, and 1981; however, all the workings were flooded or too dangerous to enter, and only a cursory examination was performed. A grab sample (915)[4] contained 0.76 ppm Au and 0.81 ppm Ag (appendix). A pan concentrate sample (916) collected from a spit largely composed of tailings from the mill contained 40 ppm Au and 7.1 ppm Ag.

Resource Assessment

No resource data are available. This property is considered by the Bureau to have high mineral development potential because of its past production and reported presence of continuous gold-bearing quartz veins. Mining was halted because of Public Law 208, not because of a lack of resources. Mining has not started again because of the low price of gold following World War II and high startup costs. The known auriferous veins occur below sea level; dewatering would be required to expose them in the existing mine workings.

Ramsay-Rutherford Mine

The Ramsay-Rutherford Mine is on the east side of Valdez Glacier at an elevation of 3,500 ft (fig. 7).

History and Production

This property was first staked in 1911 by C. A. Ramsay and H. J. Rutherford (*24*). Underground development work was begun in 1912 by the Mineral Creek Mining Co. (*24*). Development continued in 1913, with the first production occurring in August 1914 following the installation of a five-stamp mill (*24*). Development continued through 1917 and was intermittent through 1925. The largest production occurred in 1915, with 2,700 oz Au and 574 oz Ag produced from 3,136 st of ore. The Alaska Finley Co. operated the mine in 1934, but only minor production occurred (*54*). Jesse Taylor and Edgar Petropov leased the mine in 1935 and produced minor amounts of gold through 1939 (*55-56*). Total recorded production was 5,375 oz Au and 1,194 oz Ag from 5,829 st of ore (table 5).

[4]Sample numbers, in parentheses, correspond to the sample numbers listed in the appendix, which lists analytical data for each sample. The sample numbers cited in this report were derived from field records and correspond to those used in other Bureau reports on minerals in the CNF.

Operating Data

The underground workings consist of four levels: a 50-ft level at an elevation of 3,750 ft with 220 ft of drifts and caved stopes to the surface; a 100-ft level with 210 ft of drifts and caved stopes up to the 50-ft level; a 150-ft level with 50 ft of caved drifts; and a 300-ft level (mill level) with 770 ft of crosscut, 540 ft of drifts, a 15-ft winze, and a caved raise to the surface. Equipment included a 7- by 9-in Blake-type crusher, a five-stamp mill driven by gasoline engines, a small electric generator, and a 14- by 9.5- by 4-in straight-line direct-connected fuel-oil-driven air compressor. Buildings included a bunk house, mess hall, assay office, and blacksmith shop, all of which were in poor condition in 1982. Figure 8 is a surface map showing the mine's workings, geology, and a Bureau sample location at the 3,750-ft level.

Geologic Setting

The country rock consists of Valdez Group graywacke with minor interbedded slate. The general strike of the rocks is from N40° to 70°W, and dip is from 70° to 80°NE.

Gold mineralization occurs in two well-defined quartz veins. The main vein is the southernmost vein on the property; it varies in thickness from 1 in to 7 ft, with an average thickness of 2 ft. Near the southeastern end of the main vein, a short spur vein is visible. The spur vein has an average thickness of 1 to 2 ft. Small linked veins are also present. The southeastern portion of the main vein strikes from N30° to 45°W and dips 80° to 85°NE. The northern portion strikes north-south and dips 70°W. This vein has been traced for 450 ft along strike. A second vein, which averages 9 in thick, is exposed approximately 90 ft north of the main vein in the mill-level crosscut adit. The vein strikes from N45° to 66°W and dips steeply northeast.

Mineralization consists of gold-bearing quartz, which also contains silver, sulfide minerals, calcite, and siderite. Sulfide minerals consist of pyrrhotite, pyrite, chalcopyrite, sphalerite, galena, and arsenopyrite. Sulfides occur as disseminated grains (less than 1 pct), and are also present in massive bunches (*23*). Solid masses of quartz as well as vuggy crystalline varieties are present.

Table 5.—Recorded gold-silver production from Ramsay-Rutherford Mine

Year	Ore, st	Recovery, oz	
		Au	Ag
1914	668	575	122
1915	3,136	2,700	574
1916	1,400	1,205	256
1917	550	525	181
1922	39	145	None
1925	10	73	21
1934	NA	34	13
1935	NA	69	17
1937	25	48	10
1939	1	1	None
Total	5,829	5,375	1,194

NA Not available.

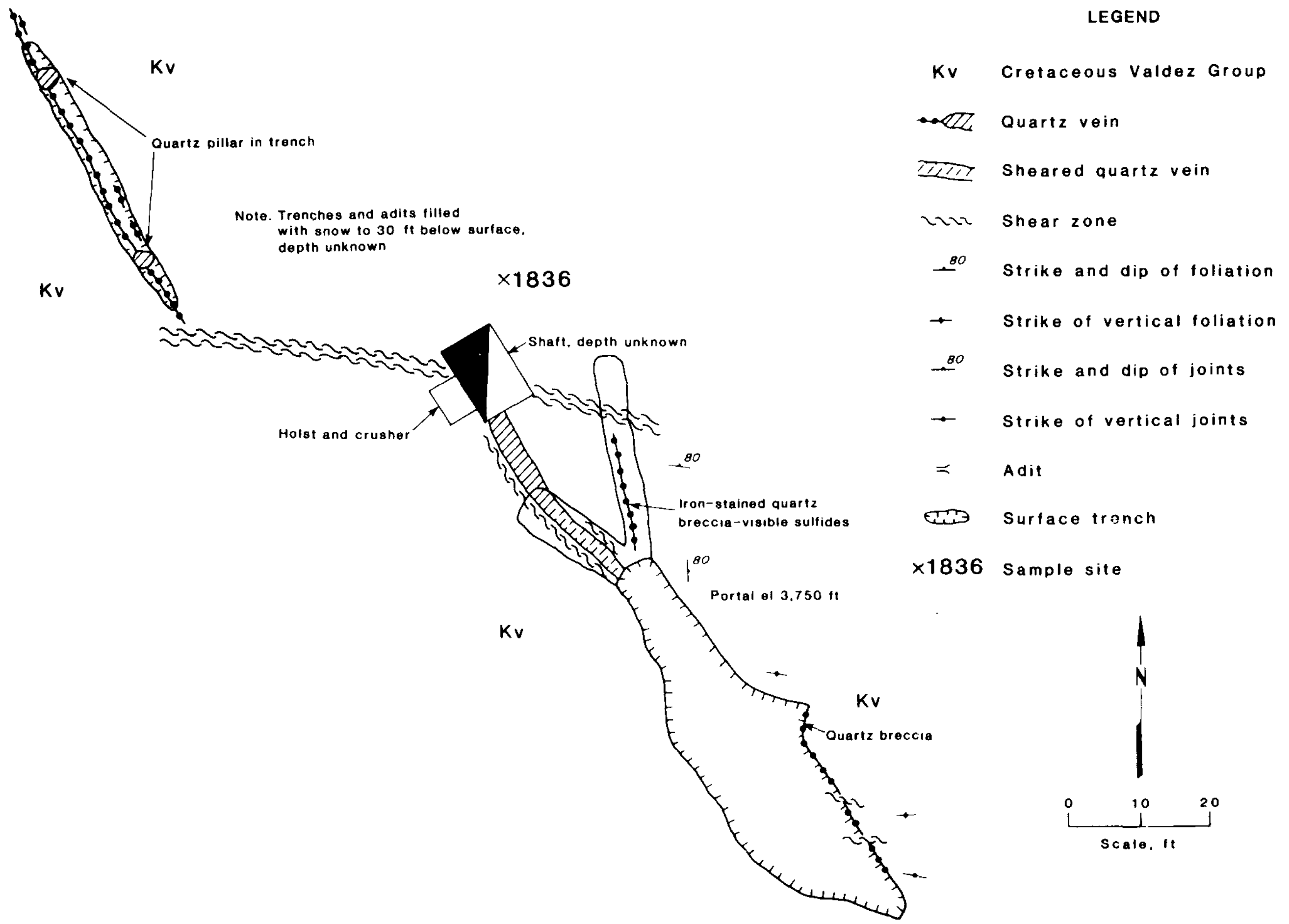


FIGURE 8.—Sample location map for 3,750-ft level of Ramsay-Rutherford Mine.

Bureau Work

The Bureau examined the property in 1980 and 1981. All of the levels were caved. Data for six samples are listed in the appendix. A grab sample (1048) from the ore bin in the stamp mill contained 2.35 ppm Au and 2.1 ppm Ag. A grab sample (1077) taken from a barrel in the assay room contained 37.5 ppm Au and 9.5 ppm Ag. A grab sample (1836) from the ore dump at the upper workings (fig. 8) contained 0.07 oz/st Au and 0.1 oz/st Ag. A mill concentrate sample (1928) contained 26.1 oz/st Au and 10.1 oz/st Ag. The gold recovered from sample 1928 yielded a fineness determination of 778 Au and 222 Ag. USGS personnel examined the property in 1979 and collected 24 samples in the area which contained from 0.05 to 28 ppm Au (*38*).

Resource Assessment

The Bureau was unable to properly assess the resources at this deposit because the workings were inaccessible. However, several Bureau samples indicate that minable grades may be present and that this deposit may have high mineral development potential.

Gold King Mine

The Gold King Mine in on the east side of Columbia Glacier, west of Mount Cameron at an elevation between 3,210 and 3,650 ft (fig. 7).

History and Production

The property was located and staked by Olaf Olsen, Frank Gustofson, and Hans Anderson in 1911 (*23*), who mined several hundred pounds of high-grade ore. The Gold King Mining Co. took over the mine in 1912 and installed a mill the following year (*23*). Total recorded production was 1,997 oz Au and 187 oz Ag from 1,560 st of ore during 1914 to 1916, 1918, and 1922.

Operating Data

Three adits were driven to develop the deposit. The 3,650-ft (No. 1 Tunnel) level is reported (*22*) to have 500 ft of drifts and crosscuts with a 60-ft winze and 90 ft of drift (fig. 9) at the bottom (fig. 8). The 3,320-ft (No. 2 Tunnel) level has 720 ft of crosscut and 350 ft of drift (fig. 9). The 3,210-ft (No. 3 Tunnel) level has a 600-ft crosscut and 55 ft of drift (fig 9). Open cuts and stripping occur on the surface. Mill equipment included a 6- by 8-in crusher; a 3.5-ft, 6-st mill; a 10-st mill; amalgamation plates; and gasoline engines.

Geologic Setting

Johnson (*24*) described the geologic setting in some detail:

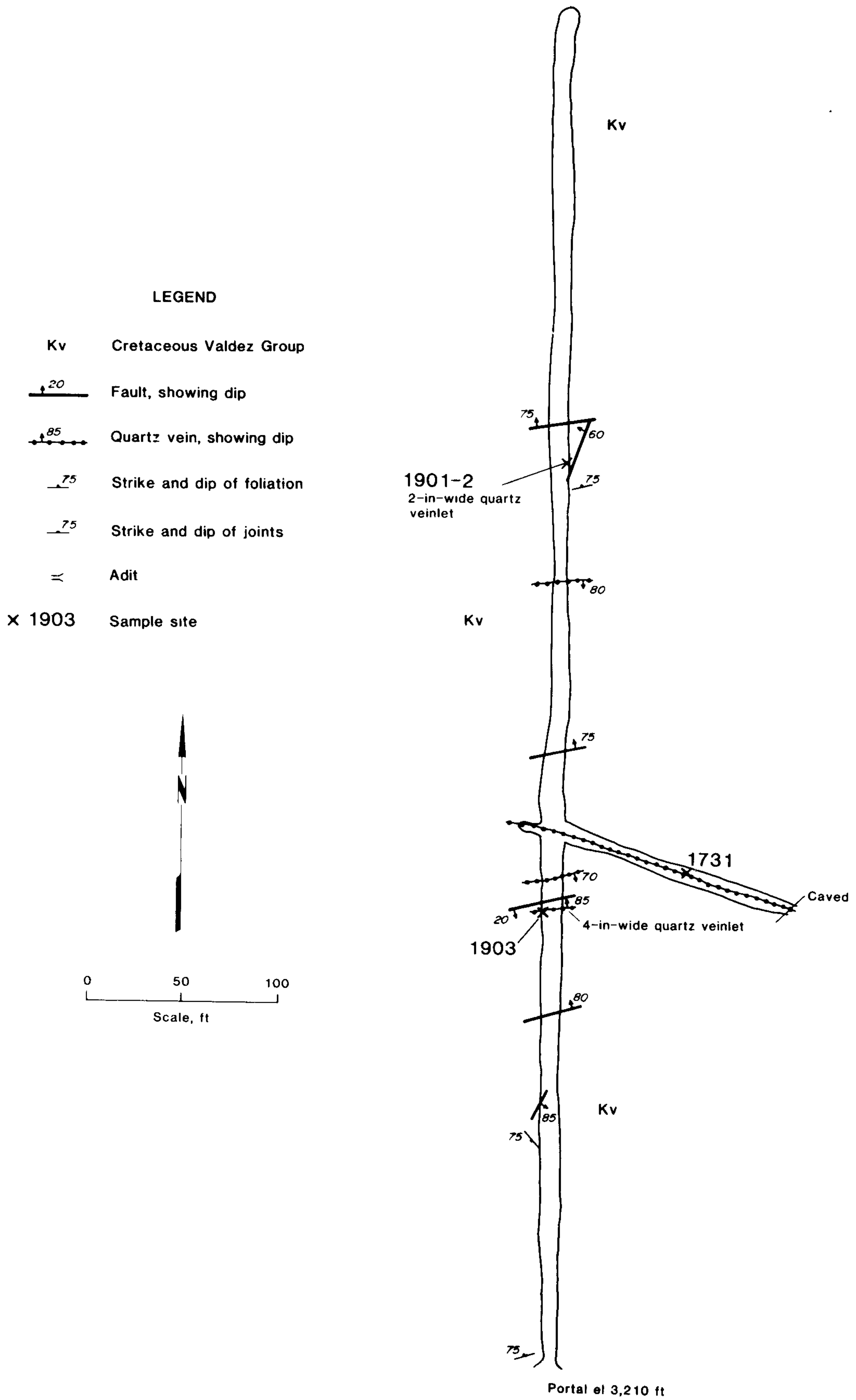


FIGURE 9.—Sample location map for 3,210-ft level of Gold King Mine.

The country rock is dominantly massive Valdez Group graywacke, containing a few zones, 50 to 100 feet in width, of thin banded argillites. The bedding strikes N65° to 72°E and dips 62°N to 90°.

Two ore-bearing veins have been developed on the Gold King claims—the upper or saddle vein (No. 1 Tunnel), on which most of the work has been done, and the lower vein (No. 3 Tunnel). Considerable development work has been done on the fissure cut by the long crosscut tunnel but this vein is said to have but slight value (No. 2 Tunnel).

The saddle vein strikes N53° to 60°W and dips 50° to 60°S. The outcrop is about 75 feet in length. On the tunnel level the vein was traced 150 feet, and 90 feet of drifting is reported on the vein at the bottom of the shaft. The westward extension of the vein is cut off by a fault which strikes N65° to 75°E and dips 70°S to nearly vertical. The filling of the fault fissure ranges from a mere seam to 18 inches in width and contains a little quartz, a maximum width of 6 inches of quartz being observed. On the west side of this fault, about 120 feet southwest of the main saddle vein, a small vein 1 inch to 6 inches wide, striking nearly parallel to the fault, has been found. The maximum width of the saddle vein fissure is 24 inches. The width of the contained quartz ranges from 1 inch to 18 inches but the usual width is from 1 inch to 6 inches. At one point the quartz occurs as narrow stringers in a belt of shattered mineralized graywacke 5 feet wide. The vein in many places shows secondary banding parallel to the walls. The vein has a good footwall but a less well-defined hanging wall. The quartz usually breaks free from the footwall but shows no gouge. On the hanging wall about an inch of gouge is present.

The fissure cut in the long lower adit (Tunnel No. 2) is well defined, strikes nearly east, and dips 65° to 70°N. The fissure filling crushed country rock ranges in width from 4- to 36-inches and contains only a few quartz stringers. Most of the fissure filling is iron-stained.

The vein east of the camp buildings is tapped by a crosscut adit (Tunnel No. 3) 60 ft long and is followed by drifts in both directions for a total distance of about 50 ft. A shallow winze was sunk on the vein at the point where it was first struck by the crosscut tunnel. This vein strikes N55° to 75°W and dips 65° to 70°N. The fissure is well-defined, has a width of 1 1/2 to 4 feet, and the contained quartz varies from 6 to 36 inches in width. In one place in the workings a width of 5 ft of quartz has been reported. The veins show considerable secondary banding parallel to the walls of the fissure, the hanging wall of which breaks free. The footwall carries from 4 to 8 inches of gouge, and in places the gouge is visible on both walls.

The ore from this property is a free milling gold ore. Quartz is the dominant gangue mineral, although calcite and a cream-colored, brown-weathering carbonate are also present. The ore contains about 3 percent of sulfides which include pyrite, galena, sphalerite, chalcopyrite, and stibnite. The gold occurs native. Pyrite cubes impregnate the graywacke adjacent to the veins. Limonite and the red and yellow alteration products of antimony-bearing minerals stain the weathered outcrops of the vein.

Bureau Work

Bureau personnel examined the property in 1981 and 1982 and collected samples from all three adits. Data for eight samples are listed in the appendix.

The No. 1 Tunnel was blocked by ice approximately 60 ft from the portal. A grab sample (7932) taken from a 3-in-thick quartz vein exposed on the surface contained 45.62 oz/st Au and 1.0 oz/st Ag.

The No. 2 tunnel, the drift along the quartz vein (shear zone), is caved approximately 200 ft from the main crosscut. The shear zone is 1 ft thick and contains small (less than 6-in-thick) quartz stringers. A 1-ft-long chip sample (1731) taken across the shear zone contained 0.09 ppm Au and 0.3 ppm Ag. Two chip samples (1901 and 1903) from other shear zones in the main crosscut contained 0.32 and 3.4 ppm Au and 0.2 and 1.3 ppm Ag, respectively.

The No. 3 Tunnel is caved 55 ft from the portal. No quartz veins are present in the adit or on the surface. A grab sample (1729) taken of quartz from the dump contained 180 ppm Au and 60 ppm silver. A chip sample (1730) across the fissure exposed on the surface contained 0.31 ppm Au and 0.3 ppm Ag.

Six samples collected by USGS personnel in 1979 contained gold values that ranged from not detectable to 9.0 ppm Au (*38*).

Resource Assessment

Lack of access prevented the calculation of resource data. High gold values are suggested by production data and Bureau sampling. The mineral development potential is unknown since no data are available concerning vein continuity.

Donohue Prospect

The Donohue prospect is on the west side of Valdez Glacier, approximately 8 miles from Valdez Arm, at an elevation of 2,700 ft (fig. 7).

History and Production

This deposit was located by the Valdez Mining Co. in 1910 (*1*). Development work was done from 1911 to 1920, and some ore was reportedly milled in 1920 (*20, 22-23, 57*). However, only assessment work has been performed since that time. No recorded production records exist for this property, but it is likely that minor production occurred.

Operating Data

Workings consist of a 470-ft adit at an elevation of 2,610 ft (fig. 10) and a shorter adit with a 50-ft winze at an elevation of 2,860 ft. Equipment remaining at the lower adit includes a gasoline engine, a ventilating fan and pipe, rails, and an ore cart.

Geologic Setting

Country rocks consist of Valdez Group schistose graywackes interbedded with argillites. The bedding and schistosity strike N83° to 89°W and dip 75° to 85°N. The

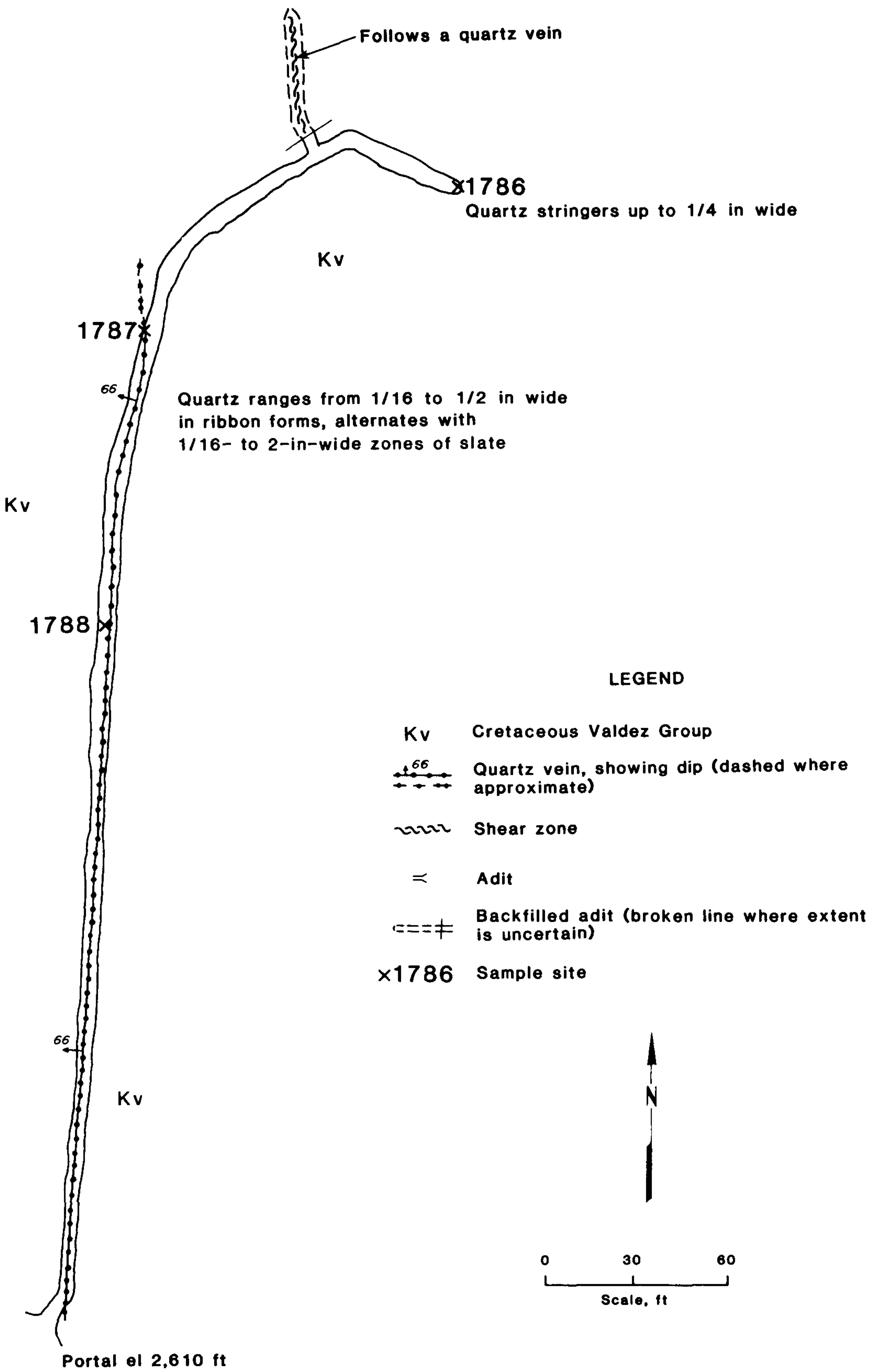


FIGURE 10.—Sample location map for 2,610-ft level of Donohue prospect.

mineralized quartz vein strikes N40°W to N80°W and dips 65° to 80°SW. The vein varies in thickness from 3 to 10.5 ft and consists of ribbon and massive white quartz. The ribbon quartz ranges from 24 to 50 in thick and generally contains higher gold values than those found in the massive quartz. Sulfides, such as galena and pyrite, occur predominantly in the ribbon quartz. Well-developed quartz crystals were also noted in the upper workings and in the tailings dump.

Bureau Work

Bureau investigators examined and sampled the property in 1981. Data for seven Bureau samples and four USGS samples are listed in the appendix. The upper adit was not mapped, but two chip samples and one grab sample of the ore dump were taken. The grab sample (1785) from the ore dump contained 1.02 ppm Au and 1.1 ppm Ag. A 1.2-ft-long chip sample (1844) contained less than 0.003 oz/st Au and less than 0.01 oz/st Ag. A 2-ft-long chip sample (1845) contained 0.413 oz/st Au and 0.1 oz/st Ag. A 10-ft-wide chip sample (500C) collected across the quartz vein by the USGS contained 13 ppm Au and 3 ppm Ag.

The lower adit was mapped (fig. 10) and three chip samples (1786, 1787, and 1788) were taken. No appreciable metal values were present.

Grab samples (1846 and 500B) were collected from a large high-grade quartz boulder. They contained 100.2 oz/st Au and 16.9 oz/st Ag and 2,500 ppm Au and 300 ppm Ag, respectively. During a return visit to the property in 1982, the owner found similar high-grade gold-bearing quartz exposed on the surface along the footwall of the quartz vein above the upper adit.

Resource Assessment

An identified resource of 2,500 st containing 0.42 oz/st Au and 0.1 oz/st Ag is present in the upper adit (18). Higher grades occur locally at the surface. This property has high mineral development potential, based upon samples collected and the potential for minable tonnage existing along strike. Further work including sampling, trenching, and possibly drilling is warranted to define the size and grade of the quartz vein.

PORT WELLS AREA

Approximately 65 lode gold occurrences have been identified in the Port Wells area. Four of these, the Granite, Mineral King, Culross, and Portage Mines, are discussed here because of their significant past production and/or moderate to high potential for future development. Other deposits are summarized in a previous report *(18)*.

Granite Mine

The Granite Mine is on the west side of Port Wells at an elevation of 700 ft, a short distance inland from the spit between Harrison Lagoon and Hobo Bay (fig. 11).

History and Production

The Granite Mine was first located by M. L. Tatum and Jonathan Erving in 1912 *(21)*, who developed the mine from a shaft and shipped 5 st of ore. The Granite Gold Mining Co. was incorporated in 1913, and considerable development work was performed in 1913 and 1914 *(45)*. On-site milling began in 1914 with 7-ft Lane mill *(21)*. The main production period occurred from 1916 to 1922, following the installation of a 10-stamp mill in 1915 *(57)*. The El Primero Mining and Milling Co. was incorporated in 1923 *(45)*, but produced only minor amounts of gold. The mine has had several owners since 1930, with minor production recorded from 1934 to 1937, 1940 to 1944, and 1963 to 1964. The current owners (1985) were planning to drill on the property to determine whether reserves exist in sufficient quantity to justify reopening the mine. Total recorded production is 24,440 oz Au and 2,492 oz Ag from 31,919 st of ore (table 6).

Operating Data

The Granite Mine and mill complex includes a mill, several buildings above the mill, storage buildings on the beach, and several mine levels. A road exists from the beach to the camp. The buildings were largely collapsed by the time investigators visited the site in 1979. However, the stamp mill remains relatively stable.

Smith *(57)* summarized the workings and equipment of the Granite Mine at the beginning of its peak production period (1916-22) as follows:

> The property was originally opened with a crosscut to an inclined shaft on the ore, since which time a second crosscut has been run on the mill level and a raise driven to tap the bottom of the shaft. The level was opened on the main vein at 50, 110, 140, 210, and 350 feet, the mill crosscut being 125 feet below the latter.
>
> The mill is in two parts, ten stamps on one side and a 7-foot Lane mill on the other. The ore on the stamp side passes through a jaw crusher to the bins where it is fed automatically to two Hendy 5-stamp batteries, the stamps weighing 1,350 lb each, falling 105 times per minute with a 6-1/4-inch drop. The ore is crushed to 40-mesh, passed over amalgamating plates, and concentrated on Wilfley and Deister tables. In the second unit the Lane is followed by 14-inch Allis-Chalmers rolls, the pulp going over plates to a Wilfley table. The concentrate from both units is shipped and the tailings stored.
>
> The main power plant, situated on the beach, contained two 80-horsepower oil-burning boilers which furnish steam for an American Ball 180-horsepower engine. The latter drives a 160-kilowatt Westinghouse dynamo. The compressor at the mine has a capacity of 620 cubic feet of free air per minute and is driven by a 100-horsepower motor. Underground, Sullivan and Ingersoll-Rand machines are used.

Machinery and equipment installed under the management of the El Primero Mining and Milling Co., was described by J. C. Roehm in 1936 *(45)* as follows:

> A new Westinghouse equipped hydroelectric power plant that cost $51,000 was installed three years ago, a mile north of the property. This includes 4,250 feet of pipe line, 20 inches reduced to 17 inches with a 340 foot head and a 140 pound pressure, a 7-foot Pelton wheel for double capacity, a 150 KVA generator and exciter complete

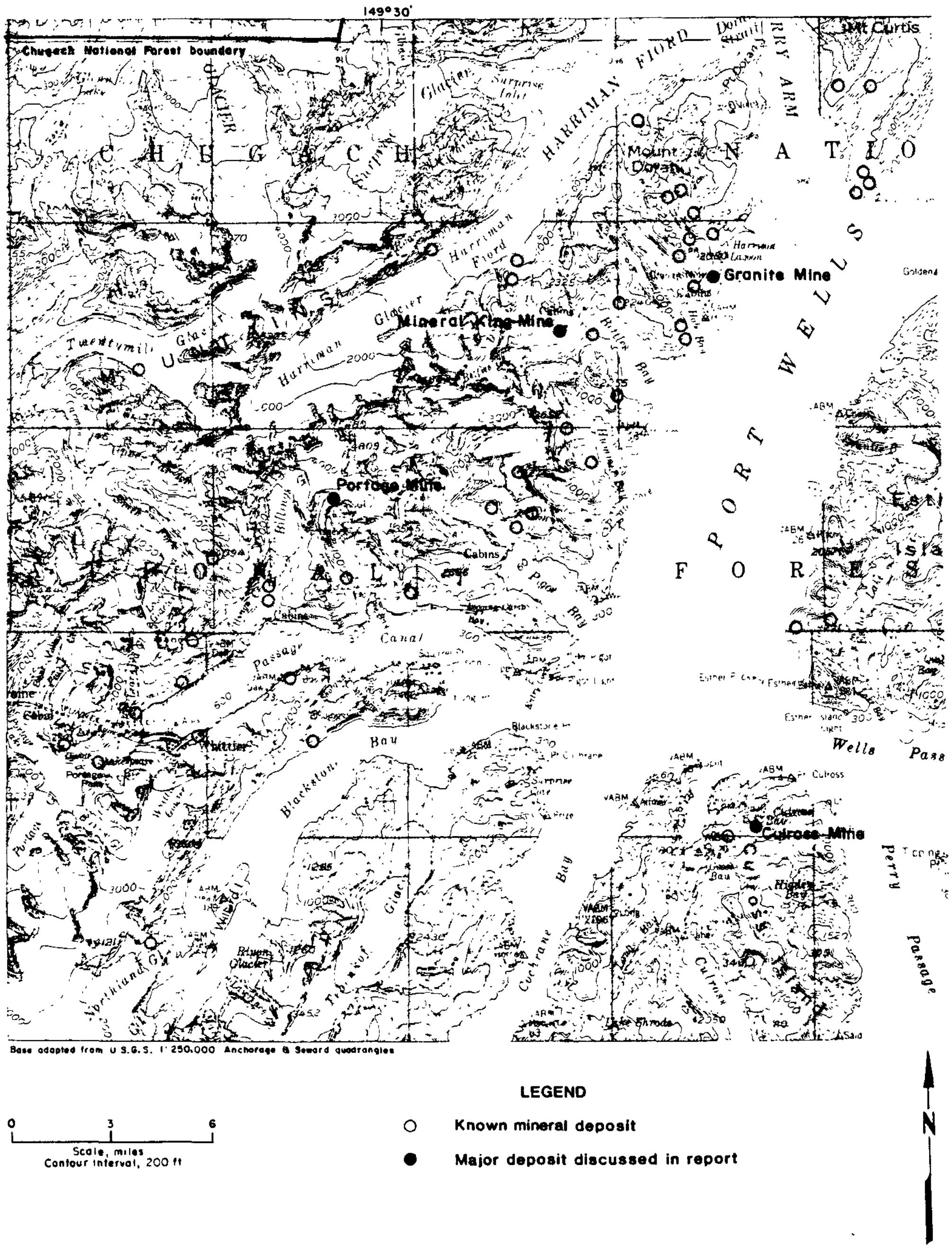


FIGURE 11.—Locations of important lode gold deposits in Port Wells area.

with glass encased automatic and safety switches. . . A Laidlow-Dunn 18 x 12 x 12 double cylinder compressor run by a 100 H.P. Westinghouse motor delivers 1,000 cu. feet per minute for the mine. The mill machinery consists of a Blake crusher with 8" x 10" jaws, run by a 25 H.P. motor, ten Joshua Hendy 1,050 pound stamps run by a 35 H.P. motor, and two Wilfley tables run by a 5 H.P. motor. The ore is crushed, and fed to stamps with inside amalgamation, through 40-mesh screen over three lengths of plates and over Wilfley tables. The recovery from battery and tables was reported 80 percent average and concentrates ran $75 to $100 a ton. These concentrates are shipped to smelter at a freight rate cost of $6 to $6.50 per ton in 100 ton lots. An Ingersoll Rand steel sharpener No. 50 is used with oil burner furnace. Ingersoll Rand leyners No. 75 are used in the mine. Auxiliary power complete for both mill and mine is installed consisting of the original power for operation before hydroelectric power. This consists of a Chicago Pneumatic single No. N-502 semi-diesel compressor that delivers 450 cubic feet per minute, a 30 H.P. Fairbanks Morse horizontal diesel for operating mill, a 6 H.P. V-type gas engine for crusher, and a 3 H.P. V-type gas engine for lights.

Table 6.—Recorded gold-silver production from Granite Mine

Year	Ore, st	Recovery, oz	
		Au	Ag
1914	3,600	3,525	NA
1915	13,050	7,052	NA
1916	10,000	4,838	NA
1917	4,250	2,266	185
1918	NA	444	290
1921	NA	1,224	376
1922	NA	1,209	372
1924	20	124	116
1930	7	283	88
1934	NA	1,210	370
1935	NA	1,233	410
1936	[e]150	275	85
1937	[e]50	62	18
1940	[e]56	28	31
1941	88	262	82
1942	100	79	20
1943	NA	23	7
1944	40	17	4
1946	[e]500	282	36
1963	8	3	1
1964	NA	1	1
Total	31,919	24,440	2,492

[e]Estimate. NA Not available.

Currently, the mine workings are accessible from the 350-ft level. Stuwe (*63*) mapped and sampled the accessible workings (fig. 12) as part of an unpublished thesis. The accessible workings total approximately 3,350 ft on three levels.

Geologic Setting

A description of the geologic setting was made in 1914 by Johnson (*23*):

> The country rock of the ore body consists of interbedded slates, graywackes, and argillites cut by large masses of medium-grained biotite granite, hydrothermally altered near the veins to a light-gray to greenish-gray rock. The granite contacts are said to be irregular.
>
> The developments suggest the presence of more than one lead on the property, but are not sufficiently advanced to prove it. The vein showing in the shaft occupies a fissure striking S75°W and dipping 60°N. In the underground workings considerable variation in the strike and dip of the vein is noticeable in the several drifts. In 1913 observations seemed to show that the vein had a general strike between N50°W and N70°W and a dip of 43°-55°N, and it is reported to be offset in many places by small faults. The fissure ranges from 3 inches to 14 feet in width and averages perhaps from 3 to 3½ feet. The fissure filling varies with the character of the country rock. In the sedimentary rocks it consists of shattered slate, graywacke, and argillite, with quartz veins or a quartz network cementing the shattered rocks and inclosing angular fragments in a network of porous white crystalline quartz. In the granite the vein is stronger and better defined, although its widest part includes numerous shattered masses of altered granite cemented by gold-bearing quartz veinlets.

Roehm (*45*) described a new vein found in 1936 as follows:

> The new vein found this year is a small vein, 4 to 12-inches in width, averages about 7 inches [and] has a developed length of 150 feet. It lies wholly within slates between a hundred and a hundred fifty feet from contact. It has a strike of N49°W and dips 65°N. This vein is highly banded with free walls showing a milky white quartz with numerous graphitic bands. Considerable free gold is showing. This vein was being mined at the time of [Roehm's] visit. The ore was sacked and trammed to mill.

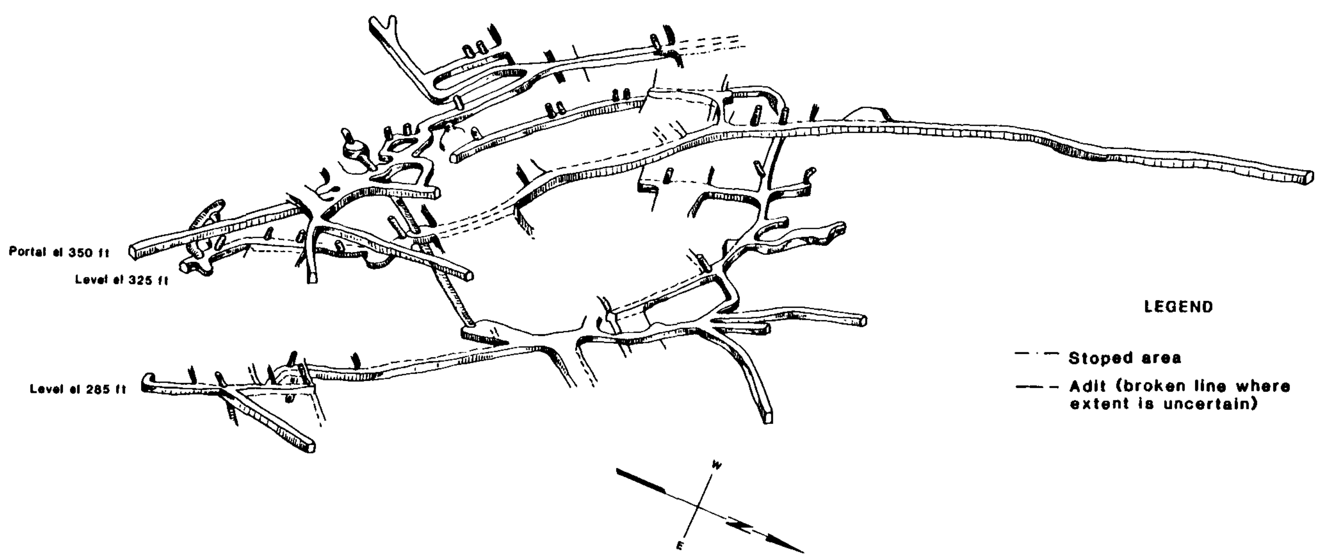


FIGURE 12.—Normal axonometric projection of accessible levels in Granite Mine.

Roehm (*45*) also discussed the mineralization present at the property:

> The mineralization consists of pyrite, galena, sphalerite, arsenopyrite, stibnite, chalcopyrite, and free gold. The gold appears to be associated with galena and sphalerite mainly, with smaller amounts of pyrite, arsenopyrite, and stibnite.
>
> The gangue minerals are quartz, calcite, graphite, chlorite, pieces of slate in the slate, and pieces of granite within the granite. The veins in the granite show refilling with large angular pieces of wall rock. The movement shows a nearly vertical upthrust with a strong action that appears to be later than the granite.

Bureau Work

Bureau personnel visited the Granite Mine on several occasions during the RARE II study. Subsurface sample locations are shown on figure 13. Samples were also collected from the dump and tailings area. Results from 23 samples are tabulated in the appendix. Samples contained from 0.02 to 71 ppm Au and less than 0.2 to 26 ppm Ag. Generally, the veins appear to have been more extensively stoped where hosted by metasediments as opposed to granite. However, high gold values were identified in samples taken from a granite-hosted portion of the vein located at the face of the 350-ft level (5740A).

A 200-lb sample (7232) of the tailings was collected in 1982. Splits analyzed by the Bureau and a commercial laboratory assayed about 0.18 oz/st Au and 0.02 oz/st Ag. The Bureau attempted to recover gold by amalgamation, but only 29 pct of the gold was recovered. The commercial laboratory performed bottle roll and simulated heap leach tests of the tailings. The bottle-roll test indicated that about 85-pct Au recovery could be obtained by cyanidation. The simulated heap leach test recovered 80 pct of the gold after 7 days. Apparently, amalgamation alone would not be sufficient to recover gold from the tailings. Much of the gold is stained due to oxidation of sulfides in the tailings.

Resource Assessment

An identified resource of 1,900 st with a weighted-average grade of 0.78 oz/st Au and 0.1 oz/st Ag was calculated using a strike length of 150 ft, a thickness of 2 ft, a depth of 75 ft, and a tonnage factor of 12. Up to 30,000 st of mill tailings containing 0.18 oz/st of leachable gold was also identified. However, the ore material exposed in the current workings appears to be nearly exhausted. Based upon past mining history and low but persistent gold values present in samples collected by the Bureau, additional work is warranted, including drilling and surface trenching to identify possible vein extensions, and detailed mapping and sampling.

This deposit has moderate mineral development potential as a lode mine. The tailings have high mineral development potential.

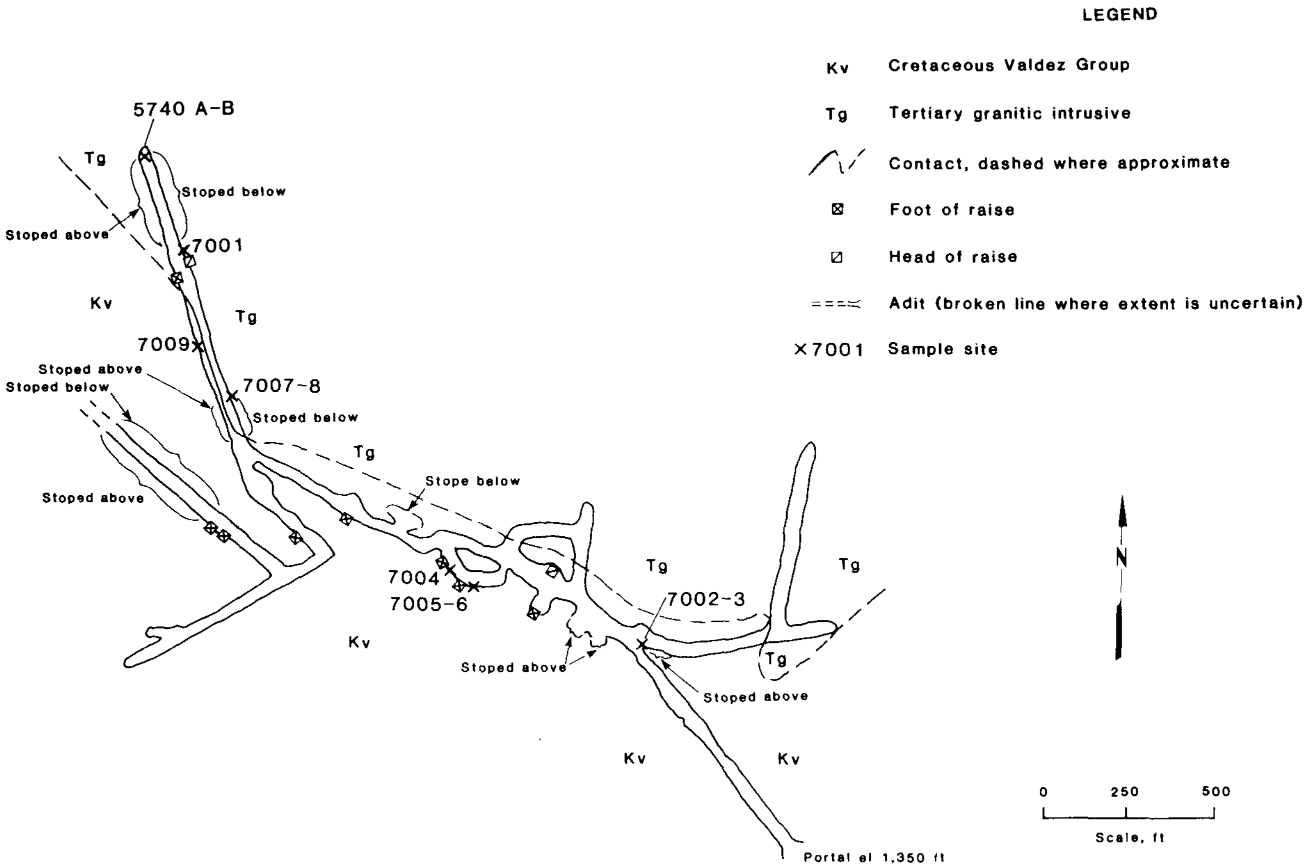


FIGURE 13.—Sample location map for 350-ft level of Granite Mine.

Mineral King Mine

The Mineral King Mine is at the northeast end of Bettles Bay, 0.75 mile from tidewater (fig. 11).

History and Production

This property was discovered by George H. Hermann in 1912 (*23*). G. A. Brook took over the property in 1917. By 1920, the property was being operated by the Alaska Pittsburgh Gold Mining Co., and over 400 ft of drifting had been completed, a 117-ft shaft had been developed, and a 10-stamp mill had been installed. A new mill was erected in 1927 by R. J. Merrill (*53*), who operated the mine intermittently until 1939. The property was relocated by M. C. and C. A. Sage in 1973 (*68*). Total recorded production, primarily from 1928 to 1933, was 2,783 oz Au and 626 oz Ag from 3,685 st of ore (table 7).

Table 7.—Recorded gold-silver production from Mineral King Mine

Year	Ore, st	Recovery, oz	
		Au	Ag
1913	35	52	NA
1927-32	3,500	[1]2,116	[e]450
1933	NA	335	90
1934	NA	17	5
1935	NA	98	30
1936	[e]50	73	17
1937	50	31	7
1938	50	42	22
Total	3,685	2,783	626

[e]Estimate. NA Not available.
[1]Production reported by Richelson (*40*).

Operating Data

The workings consist of a 750-ft-long tunnel used to haul ore from the mine workings to a 2,000-ft-long tram, a 780-ft drift at an elevation of 450 ft, a 60-ft drift at an elevation of 550 ft, and an incline connecting the workings that is collared at the surface at 650 ft above sea level. The mill is at an elevation of approximately 50 ft. A tailings pond was constructed just below the mill. Pilgrim (*61*) described the mill operation in 1931 as follows:

> The plant consists of a jaw crusher, two 1,350-lb stamps, a Wilfley concentrating table, and an Ingersoll-Rand 9 by 8 air compressor driven by pelton wheels. The water is taken from Eaton Creek and is driven under a head of over 200 feet. Ore is brought from the portal of the tunnel to the mill by a jig-back tram about 2,000 feet in length. A small 7 by 6-inch compressor driven by a gas engine is situated at the tunnel for use when water is not available for the pelton driven compressor.

Geologic Setting

The geology and mineralization at the mine were accurately described by Johnson (*21*) as follows:

> The country rock is fine-grained dark-gray graywacke and argillite. A large dike is reported to cut these metamorphic rocks about 100 feet from the vein. The ore deposit occupies a fissure and is traceable about 200 feet. The fissure strikes N26°W and dips 45° at the surface and 50°E in the lower part of the shaft. The width of the fissure filling is from 2 to 6 feet and averages about 3 feet. The proportion of quartz to shattered graywacke in the filling varies. The fissure is exposed in the stream 75 feet west of the shaft, where its filling is about 6 feet wide and consists mostly of quartz but includes some graywacke. Twenty-five feet below the collar of the shaft 13 inches of quartz occurred in a 39-inch fissure. At 60 ft the fissure was 23 inches wide, 19 inches of which was quartz. The quartz veins parallel the walls and there are very few cross fractures. Large lenses of quartz, 15 to 25 feet long, overlap, pinch out, or play out into stringers which in places unite with similar stringers from other lenses to form veins, or the stringers themselves widen until they are several inches across. The hanging wall of the fissure shows no gouge and most of the quartz veins break free from the graywacke with no gouge. The ore contains quartz, calcite, sphalerite, pyrite, galena, chalcopyrite, gold, pyrrhotite, and arsenopyrite.

Pilgrim in Stewart (*61*) also described the vein as it appeared in the workings in 1931:

> A considerable portion of the vein has been stoped out above the 100 foot level. The vein is a fissure striking N23°W and dipping 52°SE. The quartz above the 100 foot level varies in width from 2 to 6 feet and has an average of about 3 feet. The walls are dark graywacke. Below the 100 foot level, the vein is somewhat scattered into lenses and stringers following along the cleavage of the wall rock. On the tunnel level some slate is interbedded with the graywacke. The slate there strikes N56°E. Granite shows along the last 140 feet of the tunnel. Where followed by the tunnel the vein is from 1 inch to 12 inches in width and varies considerably in direction where the granite is encountered. There are a number of parallel stringers and lenses of quartz, especially on the hanging-wall side of the tunnel. A crosscut extending east from the tunnel at a point 75 feet from the face passes through the granite and into graywacke at 15 feet in from the tunnel.
>
> The ore is a white crystalline quartz containing considerable brecciated country rock. Contained sulfides are pyrite, sphalerite, and galena in appreciable amounts, and minor amounts of chalcopyrite, pyrrhotite, and arsenopyrite. Some calcite was observed filling narrow fractures in the graywacke breccia in the vein. Much of the gold is contained in the sulfides, which are concentrated in the mill and shipped to smelters in the States. Samples taken from the concentrating table by Mr. Merrill assayed as follows:

	Gold, oz	Silver, oz	Value	Iron, pct	Sulfur, pct
Concentrate A	6.58	49.30	$151.32	35.12	33.78
Concentrate B	7.18	50.80	163.92	31.97	30.73
Tailings	0.08	0.20	1.68	2.63	2.06

Bureau Work

The Bureau collected 12 samples (5417-5419, 5443-5450, and 6313) and updated the mine map of the main level (fig. 14), which was originally prepared by Shepard (*51*). The locations for 8 samples collected from the 450-ft level are shown on figure 14. Data for all 12 samples are listed in the appendix. Samples contained from 0 to 5.3 ppm Au and from 0 to 4.3 ppm Ag. The 550-ft level was not examined due to unsafe conditions. Two placer samples collected from the stream draining the mine area contained 0.001 and 0.018 oz/yd^3 Au (appendix).

Resource Assessment

An identified resource of 500 st with a weighted-average grade of 0.012 oz/st Au and 0.002 oz/st Ag occurs in the 450-ft level drift. This estimate is based upon a strike length of 120 ft, a thickness of 0.5 ft, a depth of 100 ft, and a tonnage factor of 12. Up to 5,000 st of untested tailings is estimated to occur in the tailings impoundment below the mill.

Samples collected in the 450-ft level were low in grade and suggest that the vein has little potential for development where it is hosted by granite. Previous production is reported to have come from the 550-ft level, where the vein is hosted by Valdez Group rocks (*61*). Reports also suggest that most of the high-grade quartz was mined out between 1928 and 1939 (*43, 61*). Values could increase at depth; additional evaluation, if attempted, should include both examination and sampling of the 550-ft level and drilling to intercept the vein below the 450-ft level. The mill tailings should be sampled and tested to determine their grade and amenability to heap leaching.

This deposit has moderate mineral development potential for a small lode mine and may have moderate mineral development potential for heap leaching of the tailings.

Culross Mine

The Culross Mine is 1,500 ft southeast of the head of Culross Bay on Culross Island at an elevation of 190 to 370 ft. The mill is located at sea level near the head of Culross Bay (fig. 11).

History and Production

This deposit was first discovered in 1907 (*1*). By 1914, development work included a 28-ft shaft, a 175-ft drift, and a 140-ft crosscut; and 5 st of ore had been shipped (*57*). A 10-ft arrastre mill and two gravity tables were set up on the property in 1917 (*57*) by the Thomas Culross Mining Co., which declared bankruptcy in 1918 after completing 73 ft of drifting. In 1919, the mine was taken over by the Culross Island Mining and Milling Co., which continued development through 1925 with 220 ft of tunneling, 240 ft of raising, and installation of a 650-ft^3/s air compresor (*32, 60*). Only minor development work and sampling have oc-

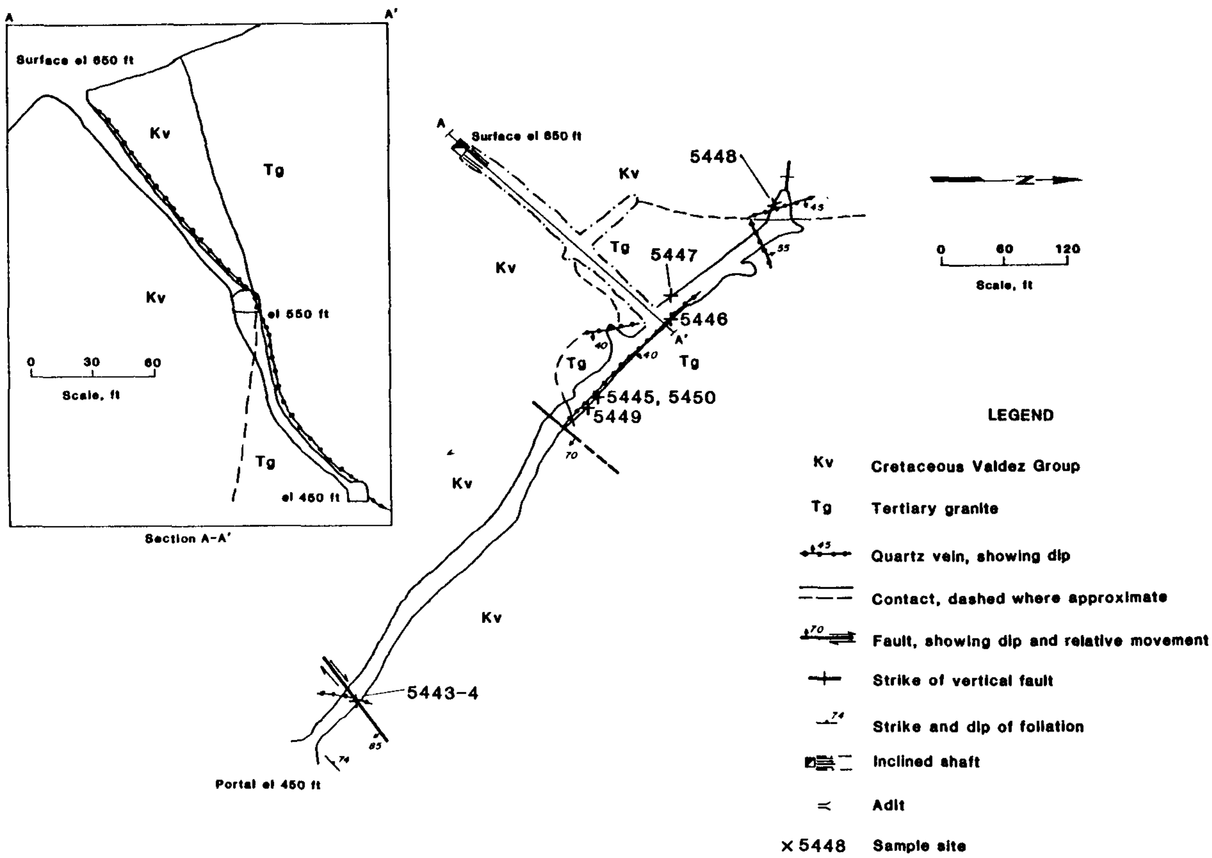


FIGURE 14.—Sample location map for Mineral King Mine.

curred since 1925. Recorded production totaled 62 oz Au and 53 oz Ag from 52 st of ore. The size of the existing stopes indicates that approximately 800 st of rock was removed from them.

Operating Data

Underground workings consist of an adit at the 190-ft level containing 185 ft of crosscut, 480 ft of drift, and several small stopes (fig. 15). A 180-ft raise extends from this level to the surface. A series of small stopes has been driven above this level. About 110 ft to the south, a second adit has been driven 50 ft, but it does not intersect the main shear zone.

A mill building enclosing a 10-ft arrastre mill, two gravity tables, a pelton wheel, and an air compressor once existed on the beach below the mine. A cable tramway connected it to the mine workings. However, the building has collapsed and the gravity tables have been removed.

Geologic Setting

The mine workings occur within Orca Group volcanics lying just east of a probable fault contact with Valdez Group slate and graywacke. Wall rocks consist of quartz-chlorite schist, with occasional pillow outlines. Mineralization occurs in quartz veins confined to a 4- to 8-ft-thick nearly vertical fault zone which trends N10° to 15°E and cuts the volcanics. This zone has been explored underground along strike for at least 410 ft and contains a 1- to 4-in-thick gouge zone that extends its entire length. Quartz-calcite stringers and veins varying from less than 1 in to 3 ft thick occur throughout the shear zone and locally account for up to 20 pct of the total rock. The veins have irregular margins, pinch and swell in a boudin-like manner, and contain quartz rod and small fold structures roughly parallel to foliation. The vein composition varies from totally quartz to all calcite, with iron staining and ribbon structure common underground. The veins contain an average of less than 1 pct pyrrhotite with occasional gold. Selected pieces of dump material contained 1 pct galena, chalcopyrite, and visible gold. Johnson (*21*) also reported arsenopyrite and sphalerite in the ore. Quartz float from several trenches in the area contained up to 5 pct galena, 1 pct chalcopyrite, and visible gold. A linear depression in which the quartz float occurs marks the surface expression of the fault zone.

Bureau Work

The underground workings were mapped and sampled where possible, although the tops of several stopes were not accessible. Sample data for 31 samples containing from a trace to 30 ppm Au and from less than 0.2 to 11 ppm Ag are listed in the appendix. One additional sample (4263), collected from the arrastre mill, contained 300 ppm Au and 65 ppm Ag. The locations of all subsurface samples collected are shown on figure 15.

Prospecting in the area east of the Culross Mine revealed some quartz float containing 1 pct arsenopyrite, but no visible gold. Several quartz veins occur in the area, but they were completely devoid of sulfides. A 10- by 15-ft exposure of shale cut by numerous quartz veinlets contained traces of copper and zinc but no precious metals.

Resource Assessment

An identified resource of 9,800 st, containing a weighted-average grade of 0.16 oz/st Au and 0.1 oz/st Ag, was identified at the Culross Mine. This estimate was based on a strike length of 480 ft, a thickness of 1 ft, a depth of 240 ft, and a tonnage factor of 11.7. A previous estimate made by Richelson (*41*) was more optimistic; he calculated a reserve of 75,000 st containing 1.5 oz/st Au, 1.5 oz/st Ag, 1 pct Cu, and 1 pct Pb.

This deposit is estimated to have moderate mineral development potential for a small precious metal lode mine. Additional sampling, mapping, surface trenching, and drilling is recommended.

Portage Mine

The Portage Mine is at the head of Poe Valley, approximately 12 miles northeast of Whittier, AK (fig. 11). The portal is at an elevation of 1,550 ft, and remnants of support buildings remain along the west side of Poe Valley at an elevation of 300 ft.

History and Production

The deposit was located by Domenic Vietti and partners in 1928 (*58*). Portage Gold Mines, Ltd. acquired the property in 1933 and performed development work with some production between 1935 and 1940 (*46*). A mine report was written for Brigitte Mining and Consulting Co., Ltd. in 1965 by Steiner (*59*), but no subsequent activity has occurred. Total recorded production is 490 oz Au and 60 oz Ag.

Operating Data

Workings are at an elevation of 1,550 ft and consist of a 278-ft crosscut, a 345-ft drift with approximately 220 ft of stoping, and 240 ft of raises (fig. 16). One 160-ft raise reaches the surface at about 1,700 ft above sea level. Several cases of unopened dynamite are present at the east end of the drift. Equipment used at the mine was described in a 1936 report by Roehm (*46*):

> This company owns a 20 hp diesel McCormick-Deering tractor which is used in hauling supplies from the beach to the camp and part way to the mine. The mine is operated with a 2-stage air-cooled Ingersoll-Rand compressor. This is [a] type 40M with 186 ft air displacement and delivers 150 feet^3. This is run by a 30 hp Gardner diesel with belt drive. Gardner-Denver machines with detachable bits are used in the mine. Timber is lacking in the vicinity of the mine. However, within half a mile of the beach an abundance is found. A seasonal water power site could be developed from the glacial stream which has approximately a 50 foot fall within 200 feet of the beach.

The compressor, diesel, and other equipment occupy a small room underground within 50 ft of the portal.

Geologic Setting

Roehm (*46*) also described the geology and mineralization of the area:

> The geology in this area is very favorable for gold deposition due to the existence of a slate and granite contact that shows considerable mineralization. This contact is located along the east side

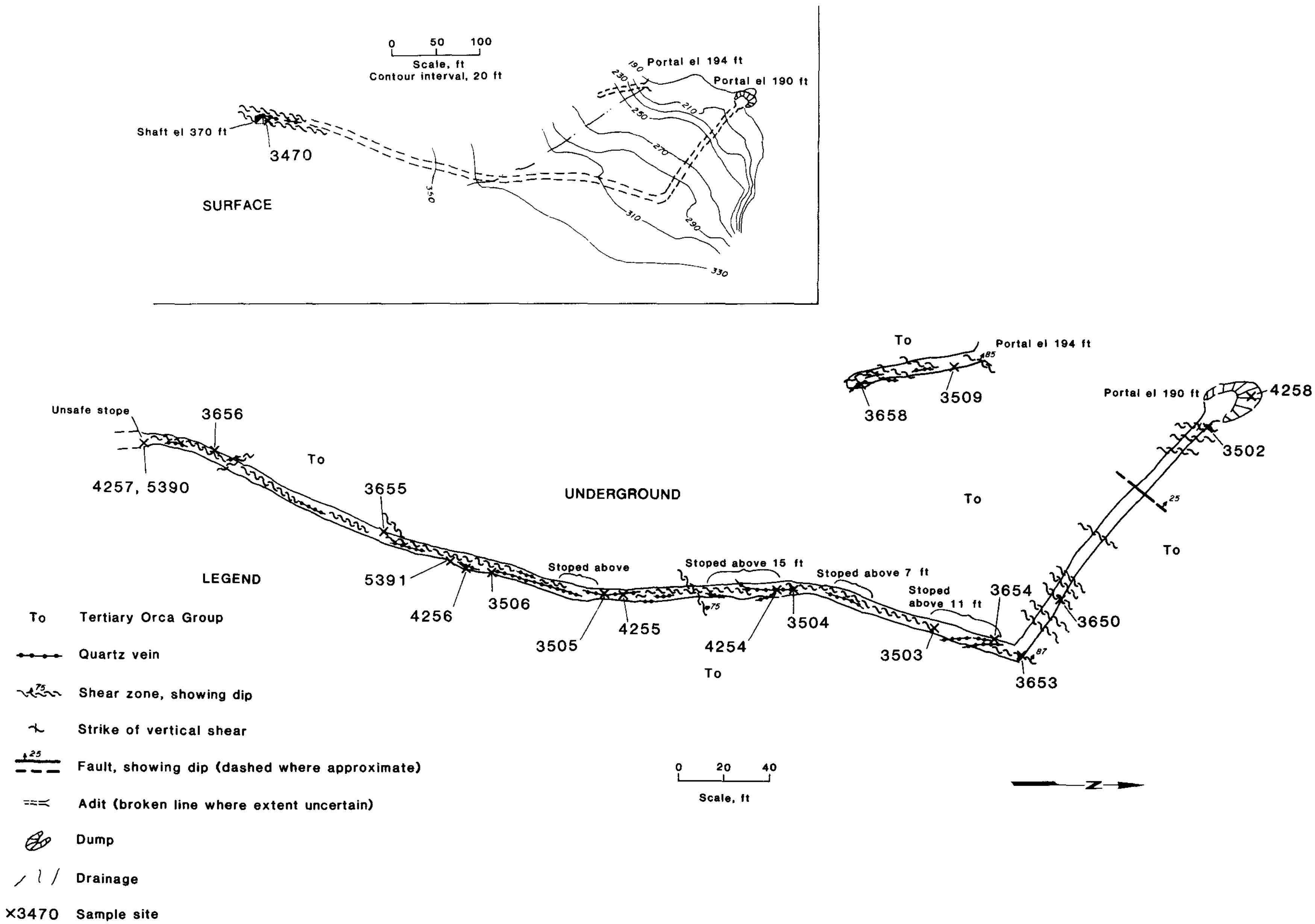


FIGURE 15.—Sample location map for 190-ft level of Culross Mine.

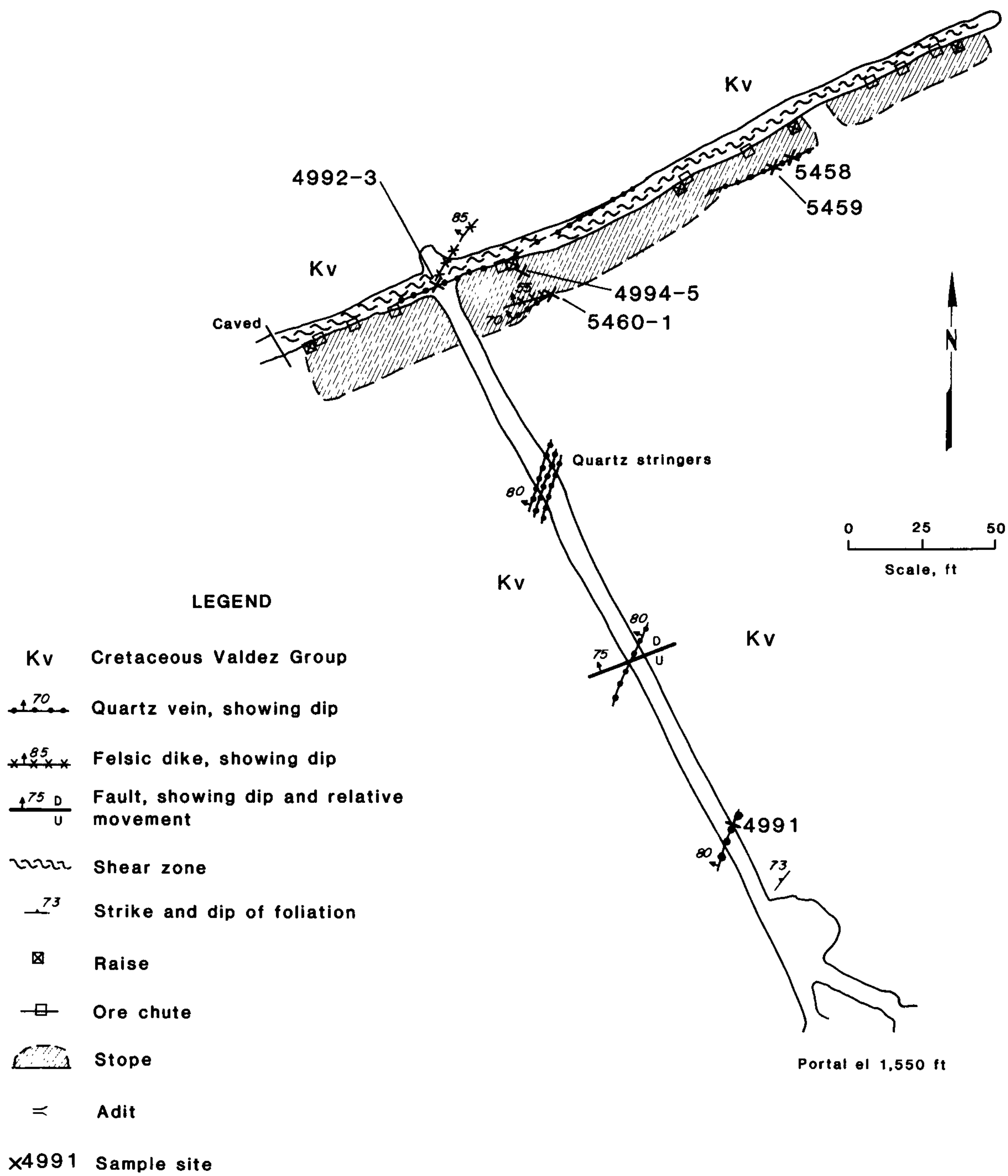


FIGURE 16.—Sample location map for 1,550-ft level of Portage Mine.

of the valley in a northerly direction cutting the schistosity of the slates at nearly a right angle. Several light greenish to gray dikes extend from the contact into the slates at various angles. The slates consist of wide bands of black graphitic slates, interbanded narrow graywacke and slates of a more argillaceous nature. Along and in the vicinity of these dikes small quartz veins have been found. The main showing on this group consists of a banded quartz lens with an exposed length of 150 feet and an average width of 12 inches. The strike of this lens is N60°E and dips 58° to 60°NW. The slate formation strikes N70°E and dips 69° to 70°NW. This gives a difference of 10° in both strike and dip between vein and formation.

The vein is enclosed in a strong shear which contains a gouge of highly crumpled slates 3-feet wide. This gouge contains the quartz lenses which vary between the walls of the gouge. The average length of these lenses is 20 to 25 feet and they vary in width from a few inches to 20 inches, as they occur along the drift. Usually barren spaces of 10 to

15 feet exist between the lenses. Where the crosscut tunnel hits the vein, a dike of greenish color was found striking N40°E and dipping NW. This dike was cut by the vein with only a few feet displacement. At a point 22 feet east of the crosscut, a raise was started on a small lens. This raise is directly under the larger surface outcrop. The quartz widened from a few inches to 12 inches at the top 30 feet above. Later reports stated this raise encountered a dike of greenish nature paralleling the vein with the vein showing a greater width and higher values.

The milky white banded graphitic quartz contains a 1-percent mineralization of (in order of abundance) pyrite, pyrrhotite, galena, sphalerite, chalcopyrite, and free gold. The mineralization and also the gold values were spotty and occur both in the quartz and along the graphitic bands. The lens on the surface over its exposed length of 150 feet and average 12-inch width was reported to average one and a half ounces of gold per ton. A 35-feet section of this exposed length was reported to average between 2 and 3 oz. Free gold can be seen in several places along the drift and the average assay was reported good.

Bureau Work

In 1980, the Bureau examined, sampled (4991-4995 and 5458-5461), and mapped the main workings (fig. 16), and collected a pan concentrate sample (4996) from the small drainage southwest of the portal. The surface exposure at 1,700 ft was briefly examined and sampled (5692A-5692E) in 1981. Data for all 15 samples are listed in the appendix. The samples contained up to 16.6 ppm Au and 6 ppm Ag.

Resource Assessment

Company reports suggest that the deposit contains 10,000 st of identified resource grading 0.6 oz/st Au and 0.1 oz/st Ag (*58-59*). Previous reports have been optimistic concerning the potential for development of this property. Smitheringale (*58*) concluded,

> The results of work during 1935 are favorable and sufficient to warrant the installation of machinery to further the rapid exploration of the vein at depth.

In 1965, Steiner (*59*) recommended,

> The existence of economical quantities of gold had been proven by former operation. The present conditions existing in the area warrant an intensive exploration program, aimed at a substantially greater development of the property than was carried out previously.

Bureau sampling indicated that the vein contains spotty but generally low-grade values of Au. However, samples could only be collected from material left behind by the original miners. The vein has good strike length and continuity up dip to the surface. Should the vein also be continuous at depth, significant reserves could exist. Other quartz veins are visible above and to the east of the current workings near the contact zone between a granodiorite stock and Valdez Group rocks. Bureau investigators agree with the following statement by Steiner (*59*):

> It is thus inferred that further exploration of the contact zone will most certainly disclose the existence of additional quartz vein systems capable of carrying gold mineralization.

The Portage Mine has moderate mineral development potential. Additional evaluation, including surface trenching and sampling, mapping, and drilling, is warranted.

MOOSE PASS AREA

Approximately 20 lode gold deposits have been identified in the Moose Pass area. Four of these deposits, the Primrose, Crown Point, Skeen-Lechner and Falls Creek, and East Point Mines are discussed below because of their significant past production and/or moderate or high mineral development potential. Other deposits are discussed in a previous report (*18*).

Primrose Mine

The Primrose Mine is on Porcupine Creek, 2.5 miles by trail from the Primrose Creek campground, at an elevation of 1,000 ft (fig. 17).

History and Production

This deposit was discovered and staked in 1911 by John Rice (*26*), who completed some surface trenching and developed a 22-ft adit. The Primrose Mining Co. took over the claims in 1912 and constructed two adits and a 75-ft inclined shaft (*26*). Chase Hubbard obtained ownership of the claims in 1914 and completed minor development work between 1914 and 1926 (*7*). Recorded production, mostly from 1912 to 1918, totals 659 oz Au and 138 oz Ag from 300 st of ore. However, Burnette (*7*), a consulting mining engineer, reported that over 4,000 oz Au had been produced by 1931. A summary of assay values and smelter runs was also made by Burnette (*7*) in 1931. He commented,

> The average value per ton of the ore from this property on the Primrose claim approximates $100.00 per ton net. A shipment made to the Tacoma smelter and including a pro-rated amount of ore from all surface ore appearing as outcrops, ran 2.45 oz gold and 1.29 oz silver per ton, or $50.64 per ton in gold. These shipments were made in order to derive from fair tonnage sampling, the average per ton of all ore taken from all ore disclosures.
>
> Other shipments of ore to the smelter of from twelve to fifteen tons and which were taken from the general mine run, showed as follows:
>
> | | | | | | |
> |---|---|---|---|---|---|
> | 5.20 oz gold | —$104.00 | 2.39 oz silver | — | $1.40 | ton |
> | 5.38 | " 107.60 | 2.22 | " | 1.33 | " |
> | 5.67 | " 113.40 | 2.70 | " | 1.61 | " |
> | 5.96 | " 119.00 | 2.67 | " | 1.60 | " |
>
> A winze has been sunk on Veins Nos. 6 and 7 to a depth of 50 ft from creek level. The first 10 ft of ore out of this shaft was shipped to the smelter and for the nine tons of ore extracted and shipped, a gross value of $105.29 per ton was realized, or approximately $100.00 per foot in depth. Some of this ore at the surface and at 10 ft in depth assayed

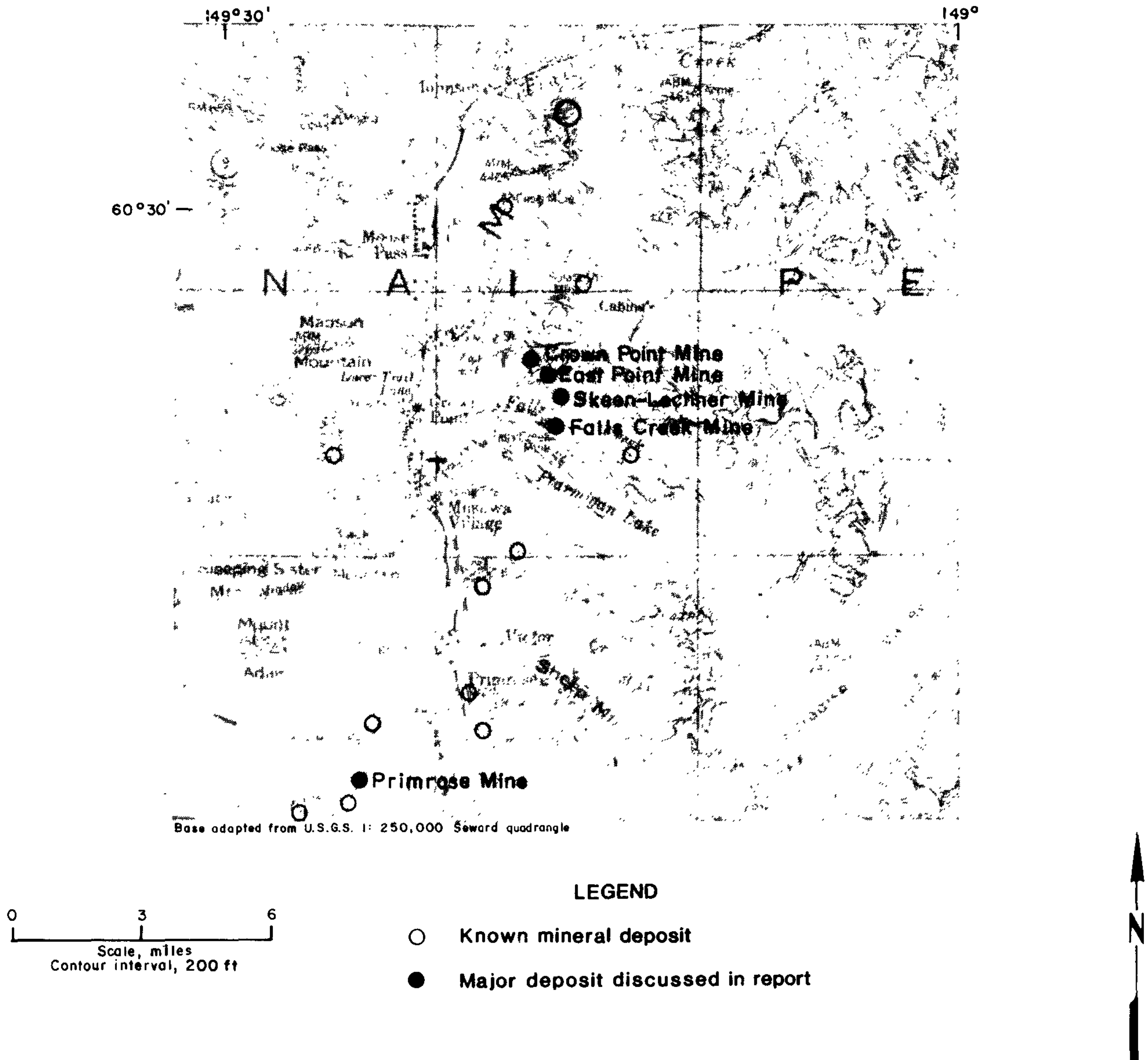


FIGURE 17.—Locations of important lode gold deposits in Moose Pass area.

$300.00 per ton. Ore assays at the bottom of this shaft (50 ft) ran $436.11 and $654.36 per ton.

A mill test was made at the property in August 1930, running through some of the ore (five tons) taken from the above mentioned shaft, which was taken out in the ordinary course of development or just a general run of mine ore. This ore plated about $38.00 per ton in free gold and ran nearly $800.00 per ton in concentrate. The general average per ton was a little over $100.00 and as only part of the saving devices were installed, much of the values were lost.

Operating Data

One cabin of the five original buildings remains standing and is in current use. Portions of the mill remain at creek level below the cabin. Three levels of workings totaling 450 ft were reported by Byram *(8)* in 1932. Portions of these workings have been reopened by the current owner.

Geologic Setting

Martin, Johnson, and Grant *(26)* describes the geologic setting and mineralization at the Primrose Mine as follows:

> The interbedded slate and graywacke in the creek bottom strikes N17°W and has a vertical dip. On the canyon walls, however, surficial creep of the beds has caused an inclination of the upper part of the lode and country rock toward the creek and has resulted in a false dip of the beds away from the creek and a strike approximately parallel to the course of the canyon. The quartz stringers at the surface dip 35° to 40°E, and at a depth of 40 feet in the incline shaft the vein is said to stand nearly vertical and to strike about N30°E. At this depth the stringers are reported to converge into a nearly solid vein 7 feet thick with well defined walls.

The gangue in the stringers is quartz, coarsely crystalline in some of the larger stringers and showing interlocking crystals in places at the center of the veins. Some calcite occurs with the quartz as a gangue mineral. Arsenopyrite is the most abundant sulfide and occurs in association with the other sulfides, sphalerite, chalcopyrite, galena, and pyrite. The gold occurs free in the quartz and also in intimate associat ɩn with the sulfides.

At the portal of the upper level, which was visited by Bureau investigators in 1982, the host rocks consist of highly fractured, incompetent slate and graywacke of the Valdez Group striking N60°E and dipping 55°SE. This attitude is believed to reflect slumping. The quartz vein exposed at the portal is 8 to 10 in wide within a 3-ft-wide shear zone striking N60°E and dipping 55°SE. The quartz contains some carbonate and has a well-developed ribbon structure caused by dark, carbonaceous-appearing bands along which fine-grained sulfides and gold have formed. Sulfides are abundant and include arsenopyrite, pyrite, chalcopyrite, galena, sphalerite, and pyrrhotite. Malachite and covellite are also present. The vein is highly oxidized and breaks freely away from its walls. Gouge is well-developed along both walls. Small vugs containing clear, euhedral quartz crystals are present.

Bureau Work

In 1982, Bureau investigators briefly examined and sampled the Primrose vein where it is exposed above the portal of the upper level. An attempt was made to reopen the portal but was abandoned due to caving. Data from the three samples collected (7174, 7175A, and 7175B) are listed in the appendix. The two samples assayed contained 1.17 to 1.57 oz/st Au and 0.6 oz/st Ag.

Resource Assessment

Available historical data and Bureau work suggest that the deposit may contain an identified resource of 1,300 st averaging 1.42 oz/st Au and 0.6 oz/st Ag (*8*). However, additional work is needed to support these estimates. This deposit has high mineral development potential based upon past production and recent sampling. Additional work, including reopening old workings, surface trenching, and sampling, is highly recommended.

Crown Point Mine

The Crown Point Mine is on the north side of Falls Creek approximately 3 miles southeast of Moose Pass at an elevation between 4,100 and 4,600 ft (fig. 17). The original mill was located on a small eastern tributary to Falls Creek at an elevation of 1,700 ft.

History and Production

Three veins are exposed at the Crown Point Mine (*26*). The Black Butte vein was originally discovered and staked in 1906. Two veins referred to as the Moon Anchor veins were staked in 1907 (*26*) but have never been developed. T. W. Hawkins, Charles E. Brown, James R. Hodden, and John Adams optioned the Black Butte vein, did some development work, and subsequently deeded the property to the Kenai Alaska Gold Co. in 1910 (*26*). Development continued in 1911, and a 630-ft aerial tram with a 5-st/h capacity and a 5-stamp mill were installed (*26*). Thereafter, the mine operated each year through 1916 with a total production of 1,852 oz Au and 428 oz Ag. The property was reopened in 1935 by the Crown Point Mining Co., and production between 1935 and 1940 totaled 1,293 oz Au and 206 oz Ag. Minor development work occurred from 1955 to 1959 by Anson Houldsberry and Edward Nielson (*1*). Only assessment work has been completed since 1959. Total recorded production is 3,145 oz Au and 639 oz Ag from 2,995 st of ore (table 8).

Table 8.—Recorded gold-silver production from Crown Point Mine

Year	Ore, st	Recovery, oz	
		Au	Ag
1911	184	412	106
1912	382	381	99
1913	230	377	60
1914	100	97	14
1915	700	346	99
1916	350	239	50
1935	110	3	1
1936	214	371	36
1937	25	97	23
1938	[e]300	426	54
1939	[e]200	230	56
1940	200	166	41
Total	2,995	3,145	639

[e]Estimate.

Operating Data

Four working levels exist at elevations of 4,170 ft, 4,320 ft, 4,450 ft, and 4,540 ft (fig. 18). Most of the two lower adits is accessible; the 4,450-ft level is caved within 50 ft of the portal; and the 4,540-ft level is caved at the portal. Stoping was extensive between the three upper levels. The lowest level appears to have been used primarily for haulage. Total development is estimated to exceed 2,000 ft, over half of which is currently accessible.

The milling and recovery procedure used during the 1911 to 1916 period of production was described by Johnson (*20*):

> During 1911 the ore sacked at the mine was hauled on go-devils to the mill, where it was passed over a 1.5-inch grizzly, the oversize going to a Blake ore crusher. It was then fed to a 5-stamp mill, the stamps dropping 114 times a minute with a 6-inch drop, the pulp being discharged through a 40-mesh screen. After passing over the amalgamating plates, the pulp went to a Risdon-Johnston concentrator. The concentrates were shipped to the Tacoma smelter and the tailings were impounded pending the erection of a plant for the recovery of their contained gold.

A more recent mill was apparently constructed just below the 4,170-ft level. However, the structure was destroyed by avalanche(s) prior to the 1980 visit by the Bureau.

Geologic Setting

Mineralization at the Crown Point Mine is hosted by Valdez Group slate and graywacke which generally strike

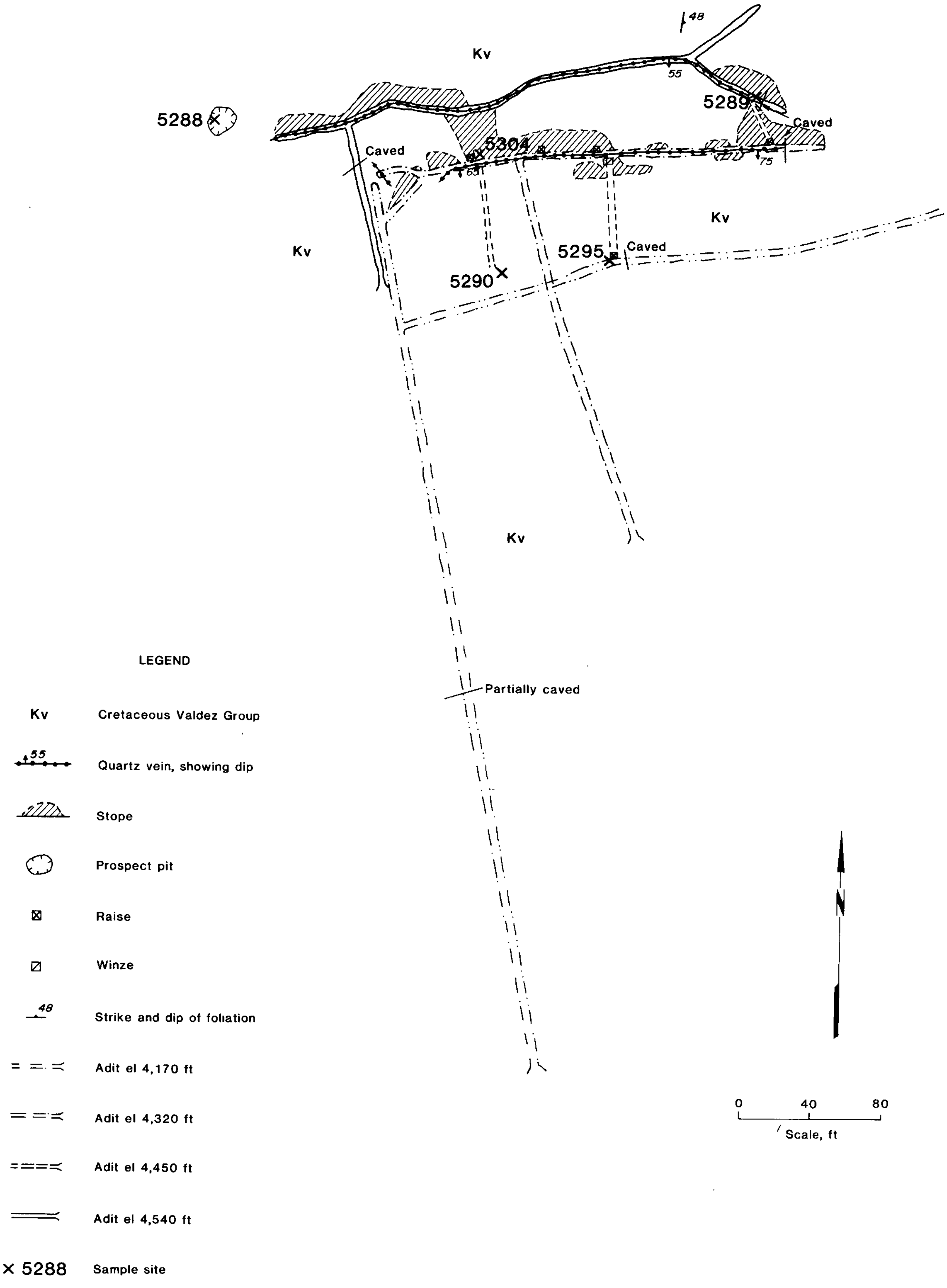


FIGURE 18.—Sample location map for Crown Point Mine except for 4,320-ft level. (See also figure 19.)

north and dip steeply to the east. Johnson, in Martin, Johnson, and Grant (*26*), discussed the structural characteristics of the ore deposit in some detail:

> The Black Butte vein occupies a fissure, formed during or after the folding of the slate-graywacke series. The strike of the fissure as shown by the plan of the mine workings (fig. 19) is sl`ȝhtly curved, varying from N50° to S83°E. The dip ranges from 65°SE to 90°. On the surface the vein has been traced for more than 1,500 feet. The width of the fissure filling ranges from 5 to 48 inches, the average width being from 20 to 30 inches. The fissure filling consists of crushed and decomposed country rock with numerous lenses and stringers of quartz which locally fill the entire fissure. The width of the quartz masses varies from 1 inch to 30 inches. Twenty measurements on several of the quartz lenses gave an average width of 11 inches. Larger and more continuous bodies of quartz have been found in the east end of the lower drift than in the west end, and most of the development work of 1911 was done in that part of the mine. Considerable movement has taken place along this fissure since the vein quartz was deposited, as is shown by the slickensided quartz surfaces within the vein, the close jointing in the quartz, and the lenticular nature of some of the quartz masses. Slickensides are also noticeable in the slate close to the veins.
>
> No development work has been done on the veins on the Moon Anchor claim and little is known regarding their size or extent. Both veins apparently occupy fissures, one of which strikes a little south of east and has a vertical dip. This vein is traceable about 200 feet. The width of the quartz filling of these veins varies from 1 to 2 feet.

Johnson (*26*) also described the mineralization present.

> The quartz gangue, as a rule, is massive and compact. The veins on the Moon Anchor claim, however, contain a few small cavities lined with well-developed quartz crystals. The vein quartz is milky-white except where discolored by decomposition products of the sulfides. Calcite occurs in the veins in small quantities. The close rhombohedral jointing of the quartz gives the ore a checked appearance.
>
> The ore is free-milling. The gold is very fine and is rarely visible to the unaided eye. The sulfides, arsenopyrite, galena, and sphalerite, form less than 1 pct of the ore. The gold is found both free and in close association with or included in the sulfides, which are fine and widely scattered through the quartz gangue. Many of the joint surfaces of the quartz are rusty and when cleaned show much fine gold, left by the decomposition of the gold-bearing sulfides.

Additional characteristics of possible significance were identified during an examination of the property by Bureau and USGS investigators in July 1980. The Black Butte vein was developed along a fault zone that apparently offset a well-defined sandstone bed by 9 ft in a right lateral sense. The vein itself is consistently offset left-laterally by northeast-striking fractures. Muscovite was identified in the Black Butte vein, which should allow the vein to be dated by potassium-argon methods.

Bureau Work

Bureau investigators examined, sampled, and mapped the accessible workings during 1980 (figs. 18-19). Quantitative analyses for 16 samples collected from the Crown Point Mine (5288-5295, 5302-5304, 5307-5309, 5684, and 7141) are summarized in the appendix. The locations of most of these samples are indicated on figures 18 and 19. Samples 5307 through 5309 are located up to 500 ft west of the 4,540 ft level, and are not shown. The weighted-average grade of the samples collected from the Black Butte vein was 0.37 oz/st Au and 0.1 oz/st Ag. The highest grade samples (5293, 5302, 5303, and 5684) were collected from the east end of the 4,320-ft level (fig. 19), from a pillar between the 4,320- and 4,450-ft levels where 50 st of material containing 2 oz/st Au and 0.5 oz/st Ag was identified.

The Black Butte vein was traced on the surface for about 1,000 ft west of the 4,540-ft level. Samples 5288 and 5308 contained high enough values (8.6 ppm and 14.0 ppm Au, respectively) to indicate that the western extension of the Black Butte vein deserves additional exploration. The east end of the vein is cut off by a northeast-striking high-angle fault of undetermined net slip. No eastern extension of the vein was located during the course of this investigation, and apparently no such extension was found by previous owners.

In 1981, a 300-lb bulk sample (5684) was collected from the 4,320-ft level to determine grade and metallurgical characteristics. This sample assayed 2.2 oz/st Au and 0.5 oz/st Ag. However, metallurgical tests were not completed. In 1982, approximately 50 lb of debris from the floor of the 4,320-ft level was collected, panned, and amalgamated (7141). Results indicated that this debris contained over 0.2 oz/st free gold. Crushing would likely liberate additional gold.

Resource Assessment

Surface sampling indicated that the western extension of the Black Butte vein has an identified resource of 31,000 st with a weighted-average grade of 0.37 oz/st Au and 0.1 oz/st Ag. This estimate was made using a strike length of 1,000 ft, a thickness of 0.75 ft, a depth of 500 ft, and a tonnage factor of 12.

Stoping of the Black Butte vein has been extensive. Only a few pillars remain underground which might be capable of supporting a small high-grading operation. Resource calculations are possible for the pillar sampled in the east end of the 4,320-ft level, where the mineralization averages 6 in thick over a strike length of 40 ft. Assuming that the vein continues up dip for 30 ft with an average grade of 2 oz/st Au (based upon samples 5293, 5302-5303, and 5684) approximately 100 oz of gold remains in the pillar.

The Crown Point Mine has high mineral development potential. Probably the best was to block out enough reserves to support a small operation for 5 yr or more would be to explore the western extension of the Black Butte vein or attempt to locate the eastern faulted-off extension of the vein by drilling.

Skeen-Lechner and Falls Creek Mines

The Skeen-Lechner Mine is approximately 3 miles east of the Seward Highway on the north side of Falls Creek at an elevation of 3,200 ft (fig. 17). The Falls Creek Mine is located on Falls Creek below the Skeen-Lechner workings. Both properties were operated by the same company throughout most of their history.

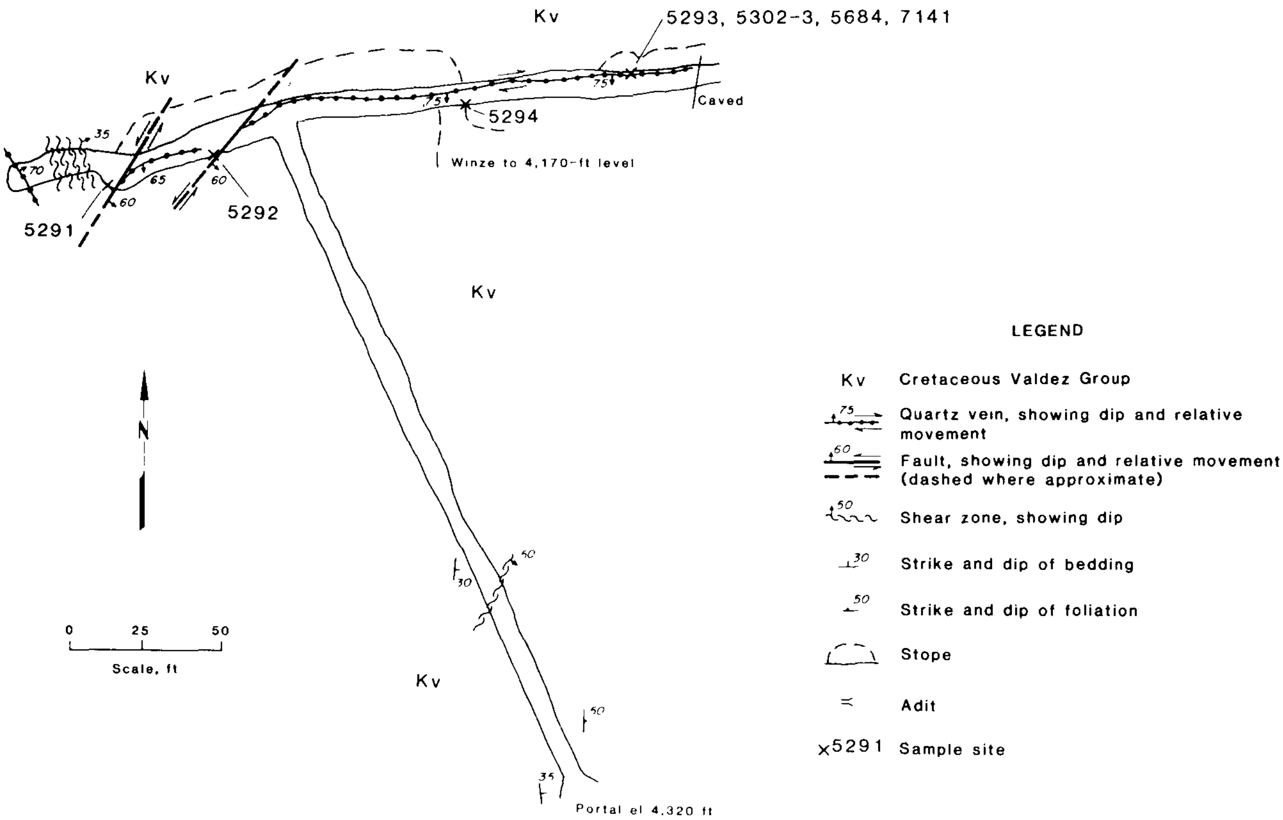


FIGURE 19.—Sample location map for 4,320-ft level of Crown Point Mine.

History and Production

The Falls Creek vein was originally located by F. P. Skeen and John Lechner in 1905 (*26*). The Skeen-Lechner veins were discovered in 1907 (*19*). Development work began on the Falls Creek vein in 1905 with the driving of a 90-ft adit and the sinking of a 20-ft winze. The California-Alaska Mining Co. purchased the Falls Creek property in 1908 and completed 140 ft of drift and deepened the winze to 40 ft (*26*). An arrastre mill was installed in 1909 and 1910, and 5 oz Au was recovered (*26*). A 2-stamp mill was installed in 1911, and 90 st of ore was milled. Development work began on the Skeen-Lechner veins in 1910 by F. L. Ballaine and J. A. Nelson (*19*). They deeded the property to the Skeen-Lechner Mining Co. in 1911, and development work continued. During 1912, the Falls Creek workings were dewatered, and the mill was fed with ore from the Skeen-Lechner property. Johnson (*26*) reported that underground workings at the Skeen-Lechner totaled 1,000 ft by 1912. Production continued until 1915.

Mel Horner acquired the Skeen-Lechner Mine in 1939 and deeded it to the Falls Creek Mining Co., which also owned the Falls Creek Mine (*19*). Minor production occurred in 1942, 1943, and from 1946 to 1950. Little work has been done since 1950. Total combined recorded production was 1,851 oz Au and 520 oz Ag from 3,286 st of ore (table 9).

Table 9.—Recorded gold-silver production from Skeen-Lechner and Falls Creek Mines

Year	Ore, st	Recovery, oz	
		Au	Ag
1911	90	65	13
1912	50	72	13
1913	900	435	141
1914	1,632	783	231
1915	20	97	3
1937	5	4	NA
1942	6	19	4
1943	40	49	26
1946	174	86	23
1947	80	24	7
1948	124	85	23
1949	110	98	27
1950	[e]55	34	9
Total	3,286	1,851	520

[e]Estimate. NA Not available.

Operating Data

Workings of the Falls Creek Mine are reported to total 860 ft (fig. 20), but they are currently inaccessible (*19*). The mill, which was destroyed by an avalanche in 1981, contained a jaw crusher, ball mill, amalgamation plates, and diesel generator.

At the Skeen-Lechner Mine, two veins were developed by three levels of workings (fig. 21) at elevations of 3,140 ft, 3,210 ft, and 3,260 ft. The middle level is currently accessible; the other two are caved at their portals, although the upper level can be entered through a raise that intersects the surface.

According to company data (*19*), workings at the end of 1950 totaled nearly 2,000 ft and were identified by type as follows (with all values in feet):

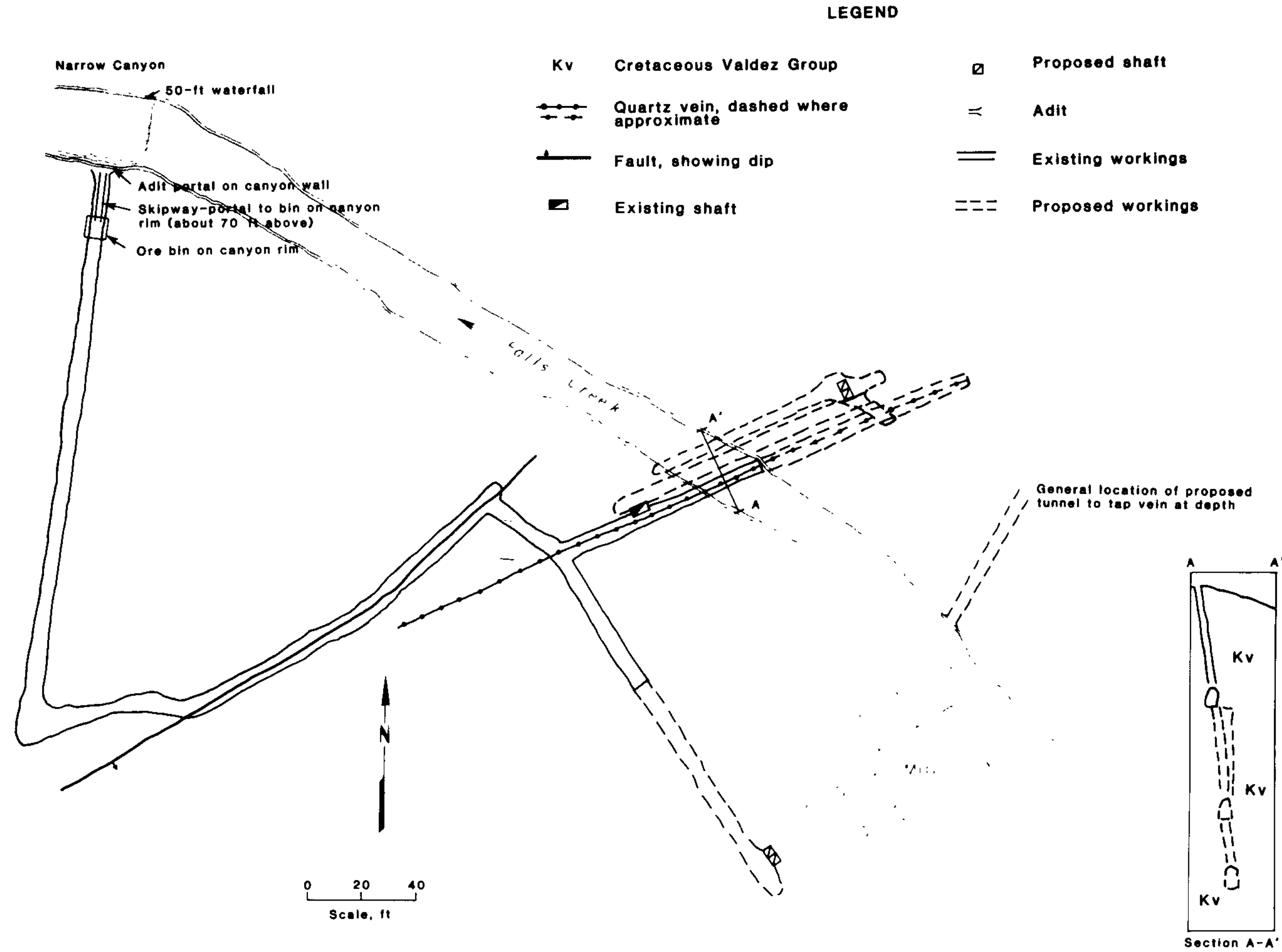


FIGURE 20.—Map of Falls Creek Mine workings.

Level and vein	Crosscuts	Drifts	Raises	Winzes	Total
3,260, lower . . .	18	204	70	5	297
3,210, upper . . .	122	193	125	5	445
3,140:					
Upper	74	38	175	0	287
Lower	300	422	170	70	962
Total	514	857	540	80	1,991

No workings were reported along the upper vein of the 3,260-ft level or along the lower vein of the 3,210-ft level. Apparently, not all of the footage recorded in the company's records was mapped on the company mine map (fig. 21).

Geologic Setting

The Skeen-Lechner and Falls Creek veins are hosted by Valdez Group rocks. Cross section A-A′, showing the veins' relationship to the 3,210-ft level, is included in figure 21 (inset) for reference. Johnson (*26*) accurately described the upper and lower veins of the Skeen-Lechner Mine as follows:

> The upper vein, occupying a fissure in the massive graywacke, strikes N15°W and dips 45°E. About midway of its present known length it is offset 40 feet on the tunnel level by a vertical fault fissure striking N56°E. The sheared zone along the fault plane is 12 to 23-inches wide and is filled with crushed country rock containing fragments of vein quartz.
>
> Slickensides are visible on this included vein quartz and on the walls of the fault fissure. In the tunnel this vein is well defined, varies in width from 20 to 45-inches and shows 1 to 4-inches of gouge on both walls. The outcrop shows much less quartz, 28-inches being the maximum measurement made, and in places the fissure filling is a sheared arsenopyrite impregnated graywacke containing only a few narrow quartz stringers. The lower vein lies about 90 feet southwest of the upper vein and has a strike of N45°W and a dip of 65°NE. It measured 46-inches at the original discovery, near the mouth of the upper tunnel. In the lower tunnel, the width of the vein varied from 1 foot to 4 feet, averaging about 2 feet. Gouge shows on both walls.

Johnson (*26*) also describes characteristics of the ore and compares the ore with that of adjacent properties including the Crown Point (Kenai-Alaska) and Falls Creek (California-Alaska) deposits:

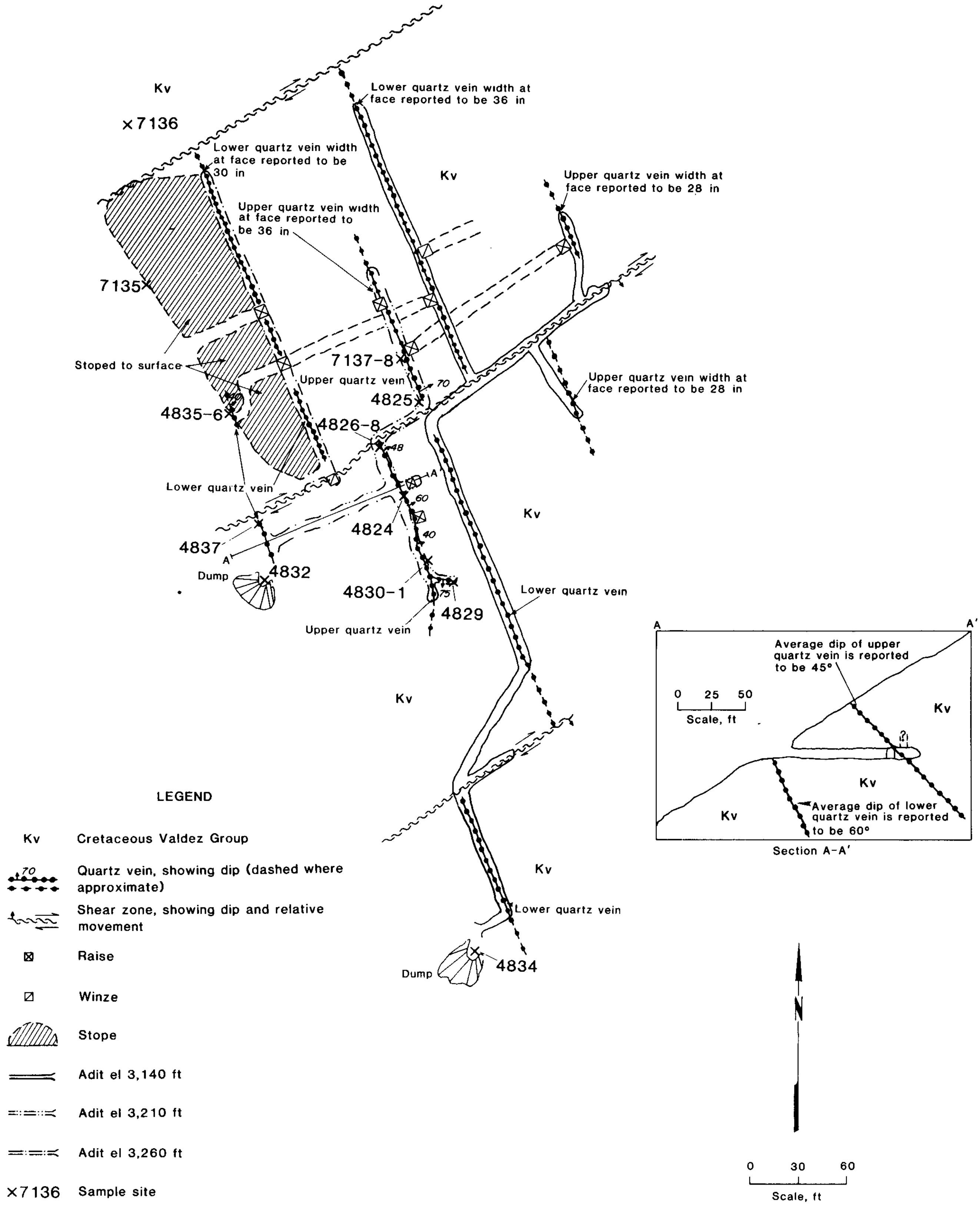


FIGURE 21.—Sample location map for Skeen-Lechner Mine.

The fissure filling of the two veins is massive white quartz, somewhat shattered and jointed. Faint indications of secondary banding are seen in some places. Only a few small crystal-lined cavities are noticeable in the vein quartz. At the western end of the outcrop of the upper vein, the quartz occurs as a network of stringers in the shattered country rock, the graywacke being considerably iron-stained. The quartz stringers here are frozen tightly to the graywacke, and narrow rusty bands, showing the former position of iron sulfides lie along the contact. The country rock is impregnated with iron sulfides at several places along the vein.

Sulfides are somewhat more abundant in these veins than in those of the Kenai-Alaska Gold Co., but they are not nearly so plentiful as in the vein on the adjacent property of the California-Alaska Mining Co. Native gold occurs in association with arsenopyrite and galena and in one specimen gold was embedded in an arsenopyrite grain. The gold and sulfide appear as small grains, no large masses being observed in either vein.

Mineralization at the Falls Creek Mine is reported to consist of an 8-in- to 4-ft-thick vein in a vertical 5-ft-thick shear zone striking N50°E in slate and metasandstone striking N10°E and dipping 75°E (*65*). Metallic minerals include arsenopyrite, galena, pyrite, sphalerite, and gold. Free gold is associated with narrow bluish quartz stringers and fine-grained sulfides.

Bureau Work

Bureau investigators examined, sampled, and mapped accessible portions of the Skeen-Lechner Mine in 1980 and 1982. Data for 22 samples (4824-4837, 7132-7138, and 7140) are listed in the appendix. Sample 4835, collected over an 18-in thickness of quartz that included 6 in of country rock from a surface exposure of the upper vein (fig. 21), assayed over 10 oz/st Au and nearly 1 oz/st Ag. The weighted-average grade of the remaining quartz samples, all collected from the upper quartz vein, was less than 0.5 oz/st Au and 0.25 oz/st Ag. The 1980 and 1982 examinations of the property were restricted to sampling portions of the upper vein that were exposed in the 3,210-ft level and at the surface.

The Falls Creek mill site was visited in 1980 and 1982. Photographs of the mill were taken in 1980 prior to the avalanche. One vein exposure located across the creek from the mill site, above what appeared to be a caved portal, was sampled (4823) and contained 3.25 ppm Au and 2.4 ppm Ag. This is not believed to be an exposure of the vein system developed by the Falls Creek Mine as it strikes N55°W and dips moderately to steeply northeast.

Resource Assessment

The Skeen-Lechner veins contain a combined identified resource of 10,000 st with a weighted-average grade of 0.82 oz/st Au and 0.3 oz/st Ag. This estimate is based upon using a length of 200 ft, a thickness of 2 ft, and a depth of 100 ft for the upper vein and a length of 360 ft, thickness of 2 ft, and a depth of 180 ft for the lower vein. A tonnage factor of 12 was used for both veins. Nearly 4,000 st of the total has been previously mined. No resource data are available for the Falls Creek vein.

The Skeen-Lechner deposit has high mineral development potential based upon samples collected and past production. The Falls Creek Mine has unknown mineral development potential since it could not be accessed. Additional exploration, including detailed mapping, surface trenching, and sampling of these properties, appears warranted.

East Point Mine

The East Point Mine, mill, and workings are at an elevation of 4,500 ft on the east side of a small glacier, 3 miles east of the Seward Highway and 1 mile north of Falls Creek (fig. 17).

History and Production

The mineralization was discovered in 1924 by John Dryer, a packer for the Crown Point Mine (*39*) who performed some development work and recovered a few ounces of gold for his efforts. Additional production occurred between 1940 and 1945 from a surface excavation near the present site of the cookhouse. Patrick Bogan and partners developed an incline and removed approximately 750 st of high-grade ore between 1954 and 1956. Due to the death of one of the partners, the mine ceased operation in 1956, and the portal was closed. Total recorded production is 1,725 oz Au and 479 oz Ag from 1,183 st of ore (table 10).

Table 10.—Recorded gold-silver production from East Point Mine

Year	Ore, st	Recovery, oz	
		Au	Ag
1928	NA	4	1
1940	[e]100	133	26
1941	22	88	26
1945	[e]300	158	49
1954	520	209	62
1955	47	318	89
1956	194	815	226
Total	1,183	1,725	479

[e]Estimate. NA Not available.

Operating Data

The subsurface workings, reported to consist of 100 ft of drift and 70 ft of winze and stopes, are currently inaccessible due to closure of the portal and the reported presence of water (or ice) in the workings (*36*). The remaining surface structures, consisting of living quarters and mill, have been badly damaged by rock falls from the vertical cliff face above. The mine is in an extremely hazardous location because of the rock falls and steep glacial and bedrock slopes that must be negotiated to reach it.

Geologic Setting

O'Neill (*36*), who examined the mine in 1960, has written the only available description of the East Point vein:

> This is a fissure vein in slate bedrock that strikes N55°E and dips 45°-60°SE. It is a strong, persistent vein, which can be traced on the surface of the cliff face for several hundred feet. Other veins are also visible along the mountain above this vein.

The vein cuts the bedding of the country rock between twenty and thirty degrees. The stoped area of the vein was about 6-feet thick though it pinches at both faces of the lower drift. The width of the vein at the northeast face is 8-inches and at the southwest face it is 12-inches. The mineralization is somewhat banded in a moderately hard white quartz. Other minerals visible are arsenopyrite and pyrite.

Bureau Work

Brief examinations of the property were made in 1980 and again in 1982. Falling rock made the visits extremely risky. The vein was exposed after digging approximately 150 ft north of the cookhouse. There the vein is 4 in thick, strikes N25° to 30°E, and dips 40°SE. The quartz contains disseminated grains and veinlets of pyrite, arsenopyrite, minor galena, sphalerite, and gold. Three samples collected by O'Neill in 1960 and two Bureau samples (4838 and 7139) contained up to 6 oz/st Au and 2 oz/st Ag (appendix).

Resource Assessment

O'Neill (*36*) calculated that over 3,700 st of ore grading 2.35 oz/st Au and 0.5 oz/st Ag occurs on the property. Data from smelter returns and samples collected by O'Neill and the Bureau indicate that the East Point vein is high grade. The weighted average of six shipments to the Tacoma Smelter in 1955 and 1956, as summarized by O'Neill, was 4.92 oz/st Au and 1.37 oz/st Ag.

The past production history, sample data, and a discussion with Patrick Bogan indicate that this property has high mineral development potential and that additional exploration is warranted. Preliminary evaluation should include geologic mapping to establish the relationship between the East Point, Crown Point, and Skeen-Lechner veins; reopening of the portal to allow for detailed subsurface sampling of the vein; and sampling of the vein at the surface. The unsafe nature of the terrain cannot be overemphasized. Protective measures should be taken, including the use of climbing gear, hard hats, and rock shelters.

SUMMIT LAKE-PALMER CREEK AREA

Approximately 50 lode gold deposits have been identified in the Summit Lake-Palmer Creek area. Five of these deposits were chosen for description below because of their significant past production and/or moderate to high potential for future development; they are the Gilpatrick, Heaston-Oracle, Hirshey-Lucky Strike, and Nearhouse Mines, and the Summit Vein prospect. In addition, the characteristics and development potential of two mineralized dikes in the area are discussed. Other deposits in the area are summarized in a previous report (*18*).

Gilpatrick Mine

The Gilpatrick Mine is on the south side of the divide between Summit and Slate Creeks, 1 mile west of the Seward Highway, at an elevation between 2,400 and 3,400 ft (fig. 22).

History and Production

J. C. Gilpatrick first recognized gold-bearing quartz veins in the Summit-Slate Creek area in 1906 and discovered the mineralized Gilpatrick dike in 1908 (*26*). Several leaseholders produced minor quantities of gold between 1908 and 1935. The United Mining and Development Co. took over the property in 1936 and subsequently constructed a mill and performed considerable development work (*42, 44*). Production commenced in 1937 and continued until 1948. Little activity beyond assessment work occurred until 1985 when a road was constructed to the mine and the workings were partially reopened. Total recorded production was 3,545 oz Au and 1,099 oz Ag from 3,664 st of ore (table 11).

Table 11.—Recorded gold-silver production from Gilpatrick Mine

Year	Ore, st	Recovery, oz	
		Au	Ag
1914	10	24	NA
1916	16	19	20
1919	16	77	40
1934	NA	31	NA
1937	NA	168	62
1938	142	112	33
1939	105	262	89
1940	1,198	1,442	451
1941	700	564	155
1942	387	398	117
1944	40	35	10
1945	[e]150	56	17
1946	[e]225	89	25
1947	[e]575	227	68
1948	100	41	12
Total	3,664	3,545	1,099

[e]Estimate. NA Not available.

Operating Data

The Gilpatrick Mine originally consisted of seven claims along the Gilpatrick dike on the divide between Summit and Slate Creeks (fig. 23). A gravity-fed mill, destroyed by an avalanche during the winter of 1979-80, was located in Slate Creek valley. Development work consisted of three adits at elevations of 2,850, 3,300, and 3,400 ft and numerous prospect pits on the north side of Slate Creek. A trench at an elevation of 2,400 ft and additional prospect pits are exposed on the south side of Slate Creek. The upper adit is currently accessible. Portions of the middle adit were reopened in 1985, but entry is considered hazardous.

Roehm (*42*), while working for the Alaska Territorial Department of Mines, visited the mine in 1941 and described the operations occurring at that time:

> Operations were resumed on March 26 of this season with one shift in the mine. June 3 the mill resumed operations and 120 tons of ore was milled during a period of 29 days. A total of seven men have been employed, five of which were in the mine and two in the mill.
>
> Underground development to date this season consisted of 170 feet of drift and some stoping. Development work has been confined to No. 2 tunnel, elevation 3,300 feet. This tunnel driven along the Gilpatrick dike, has a length of 470 feet. A raise 230 feet in from the portal extends to No. 3 tunnel above. The ore mined and milled by this company has been from a small ore shoot between No. 2 and No. 3 tunnels. Two small crosscuts, one 40 feet and one 20 feet, with drift, raise and stope, make up the workings on this level. On date of visit the ore and dike both were lost in the end of No. 2 tunnel. Since an offset of 60 feet is shown on the

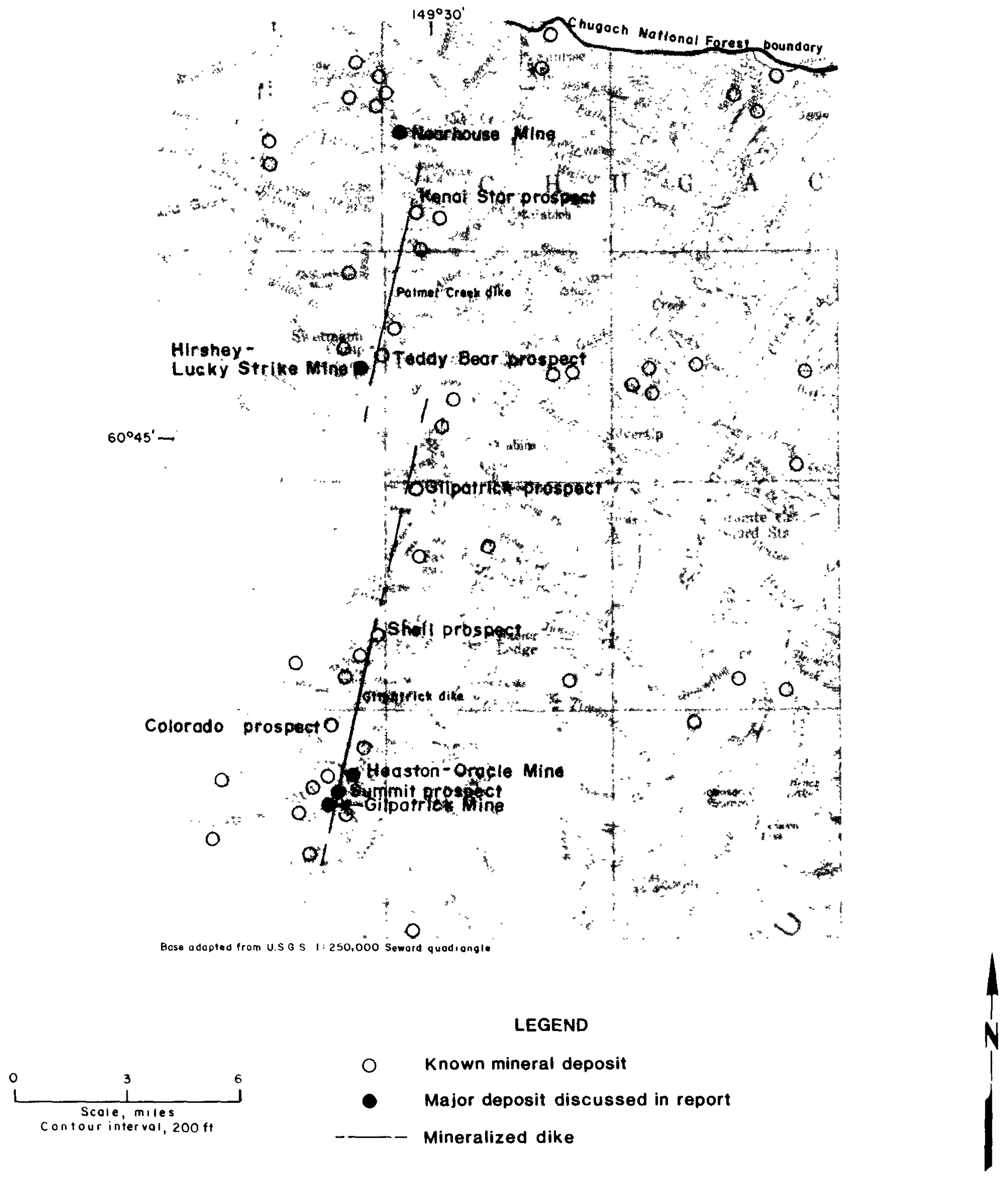
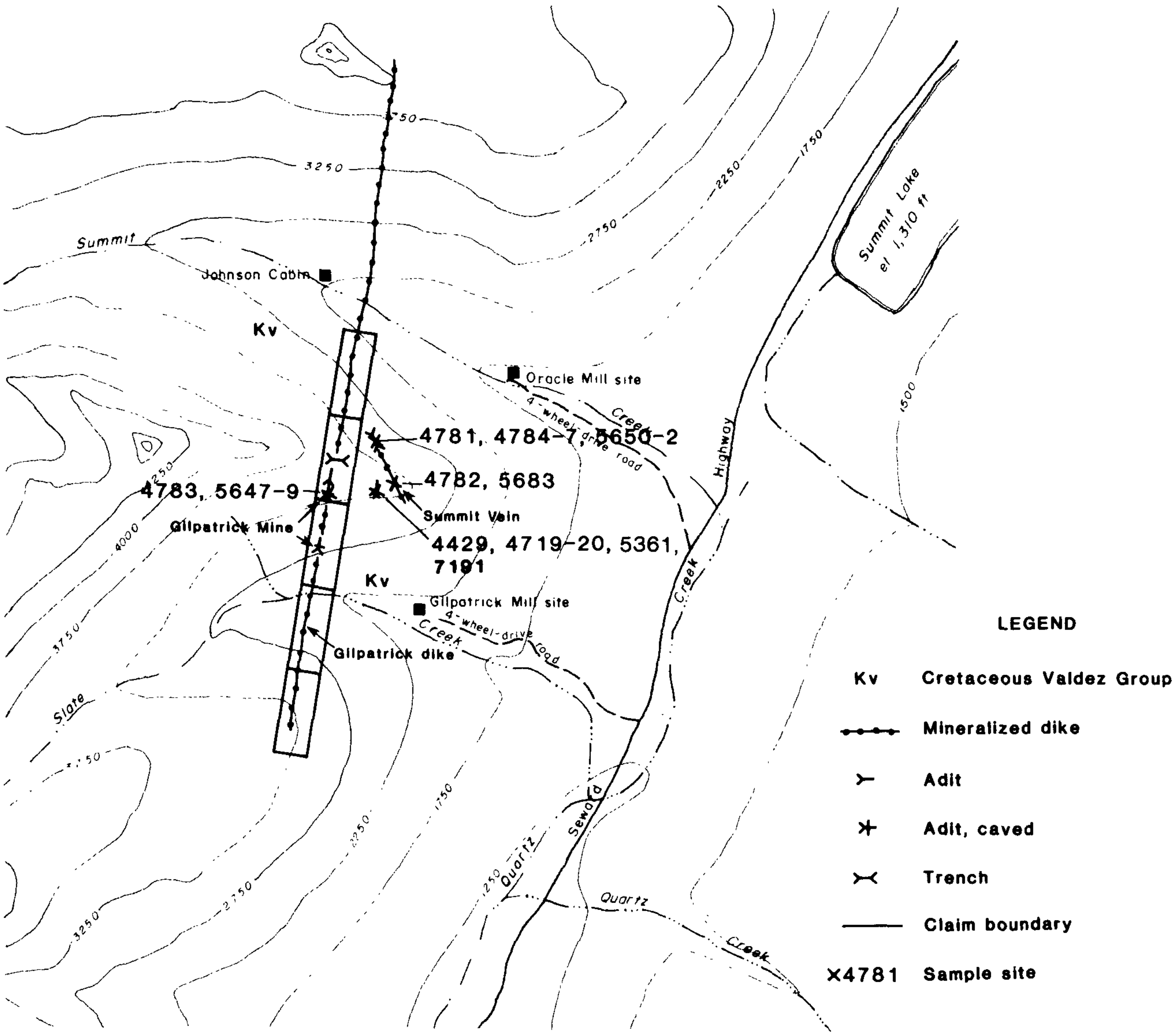


FIGURE 22.—Locations of important lode gold deposits in Summit Lake-Palmer Creek area.



Base adapted from U.S.G.S. Seward (C-7) 1:63,360 quadrangle

FIGURE 23.—Sample Location map for Gilpatrick Mine and Summit Vein prospect.

surface of the dike, due to a south fold rather than fault displacement, a crosscut into the footwall near the face of the tunnel has been started. The ore bodies occur as curved lenses alongside the Gilpatrick dike and in south plunging structures formed by the south folding of the dike in the slate graywacke sediments.

The mill has been nearly completely refurnished since its original construction two years ago. Two Fairbanks Morse diesel engines, one 25 hp and the other 15 hp, furnish power via belt to the main shaft line. The ore is trammed from the mine to the mill via a 3,000 ft aerial gravity tram with 7/8-inch cable, 5/8-inch carrier cable, and 700 lb buckets. Thence it is dumped into a 26-ton ore bin which feeds a 9 × 12-inch Denver crusher with fines passing through a 1/2 inch rod grizzly to a 65-ton ore bin below. From this ore bin a Gibson rotary feeder supplies material for the 25-ton Denver Equipment ball mill. The mill grinds to 40-mesh and the flow is pumped with a centrifugal Denver sand pump to a Denver Equipment jig located above the ball mill in which 70 percent of the gold is recovered in a concentrate which is amalgamated in an amalgam barrel. The oversize from the mill is fed to a Denver Equipment rake type classifier with overflow passing over a 30-inch × 6-ft plate and oversize returning to mill circuit. The overflow from the jig passes over a 30-inch × 6-ft plate and into the classifier.

Considerable development work must have occurred after Roehm's visit, because a total of 846 oz Au and 249 oz Ag was produced after 1941 (*68*).

Geologic Setting

Mineralized veins at the Gilpatrick Mine are hosted by Valdez Group slate and graywacke and the Gilpatrick dike. Tuck (*65*) described the Gilpatrick dike and pertinent structural relationships in some detail:

> The dike ranges in width from 1 to 12 feet, with an average of 4 to 5 feet. It is best exposed in the lower tunnel. Here it lies in slate, the cleavage of which strikes north to N15°E and dips 65°-85°E. The trend of the dike, which stands vertical, is closely parallel to the cleavage of the slate but in general is a few degrees east of north. The dike is cut by a number of transverse faults that cut across it in a direction N60°E and with a dip from 75°NW to vertical. Along these transverse faults the movement has invariably been the same, so in drifting on the dike and finding it offset, a good general rule is to turn to the right along the fault surface. The relative movement has been such that the north block has moved down and to the right in respect to the south block. In some places where slickensided surfaces indicated a purely vertical movement, the offset to the right can be explained only by assuming that the dike has a steep west dip. The horizontal component of the movement where actually observed is from a few inches to 15 feet.
>
> In addition to these transverse faults there are numerous faults that parallel the dike, as in many places there is several inches of gouge between the dike and the wall rock, and both faces may be highly polished from the movement. Between the lower and middle tunnels there are probably several transverse faults, as the position of the dike is considerably to the right of the point where it should be expected if the strike of the lower tunnel were projected. The middle tunnel as observed at the portal trends N7°W and has been driven in massive graywacke.
>
> At the upper tunnel the dike strikes about north and shows a width of at least 10 feet. The west wall has more the character of graywacke. The dike is cut again here by faults that strike N45°-60°E and stand about vertical.
>
> Associated with the dike and in general parallel with it are quartz veins, 2 to 12 inches in width. At some places these veins lie at the contact of the dike and the country rock; elsewhere they may be separated from the contact by 2 to 10 feet of slate or graywacke. The dike itself has been highly fractured in many places, and the fractures have been filled with vein material. The fractures may be irregular but more commonly have a similar orientation, suggesting that the deformation of the dike is due to a regional stress. The veins and veinlets in the dike range in width from a fraction of an inch to 8 or 10 inches; they do not extend from the dike into the country rock but terminate abruptly and are apparently due to the greater brittleness of the dike rock in comparison with the country rock.
>
> The vein filling is predominantly quartz with small amounts of calcite. Contemporaneous with the quartz are small amounts of arsenopyrite, pyrite, galena, sphalerite, and free gold. The massive dike rock contains many well-formed crystals of arsenopyrite. The fracturing of the dike has been highly erratic, and the amount of quartz filling varies greatly from place to place. In some places the dike may contain as much as 35 percent vein material; in others it may be massive and blocky with negligible quartz.
>
> The valuable minerals are in the quartz stringers and veinlets, but the richness is not proportional to the amount of quartz. The tenor is very erratic, although in places free gold is easily visible. Only very thorough sampling as well as systematic development could determine the feasibility of mining the dike.

A northwest-striking vein containing visible gold occurs above the upper-level portal, indicating that structures in addition to those described above should be examined. This vein parallels the Summit Vein.

Bureau Work

Surface and subsurface sampling (4429, 4719-4720, 4783, 5361, 5646-5649, and 7191) and sketch mapping were done in 1980 and 1981. The lower two adits were caved and inaccessible. The upper level was open and was sketched in order to show structural relationships, geology, and sample site locations (fig. 24). Quantitative data available for 10 samples collected from the Gilpatrick claims are listed in the appendix. The samples contained up to 8.5 oz/st Au and 3.2 oz/st Ag. Visible gold is readily found in quartz specimens collected from the dumps and from the northwest-striking vein exposed above the portal of the upper level (sample 5649).

Resource Assessment

Sampling indicated the presence of an identified resource of 2,000 st with a weighted-average grade of 0.89 oz/st Au and 0.65 oz/st Ag. This estimate is based upon a strike length of 470 ft, a thickness of 0.5 ft, a depth of 100 ft, and a tonnage factor of 12. However, there is not enough information available to allow meaningful resource calculations for this property. Due to its production history, the presence of visible gold in exposed quartz, and high assays obtained to date, additional exploration is warranted. The caved workings should be opened, mapped, and sampled; and drilling should be used to determine the amount of vein offset along the right-lateral structure mapped in the upper level and to determine whether significant enough quantity and quality of mineralization remains to warrant additional development. Based upon available information, this property has high mineral development potential.

Summit Vein Prospect

The Summit Vein prospect is about 1 mile west of the Seward Highway near the crest of the divide between Slate and Summit Creeks at an elevation of 3,400 ft (figs. 22-23).

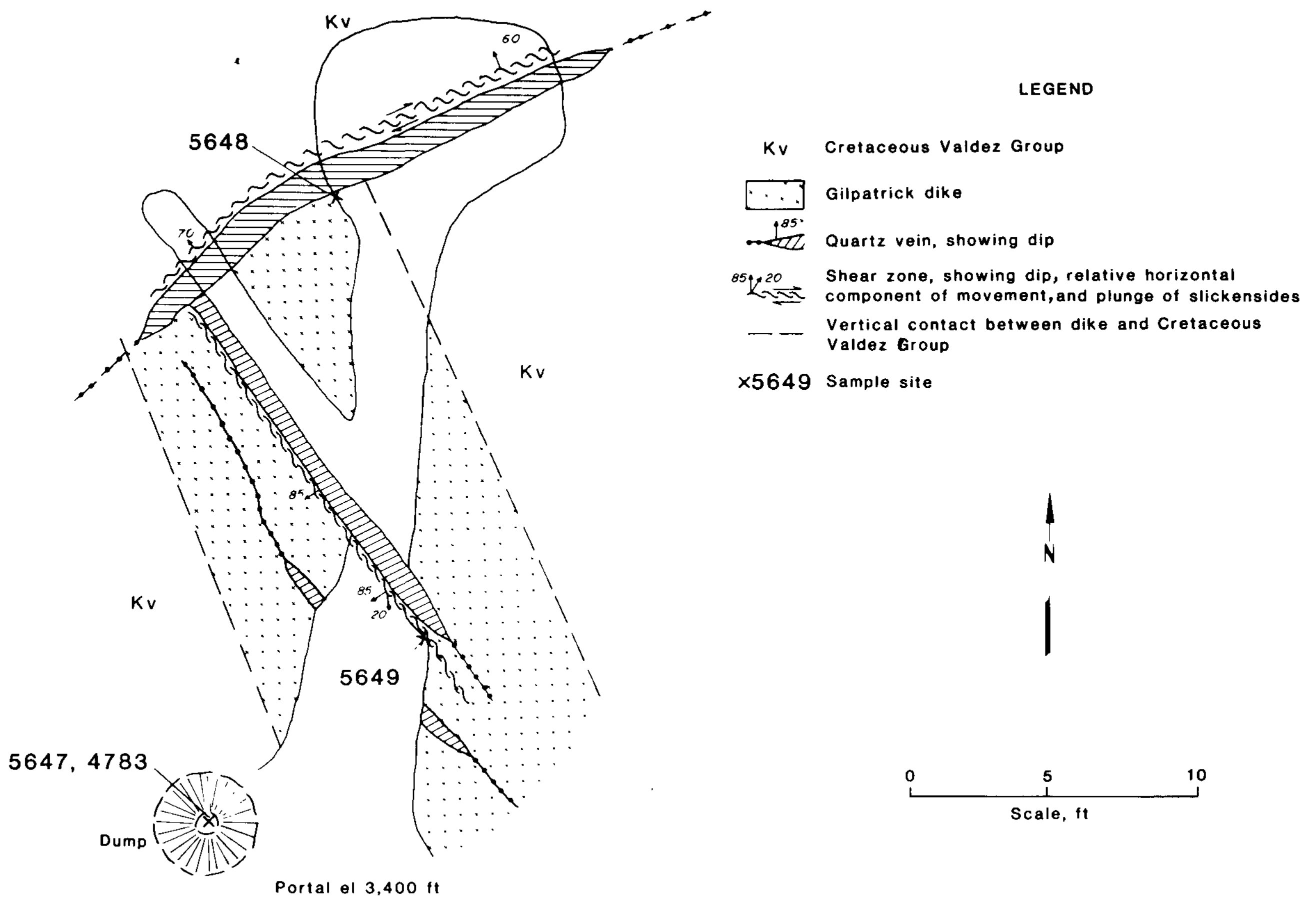


FIGURE 24.—Sample location map for upper level of Gilpatrick Dike Mine

History

No mention of this prospect was made in the literature until Tuck (*65*) visited it in 1931. Apparently the vein was prospected along with several other veins in the area during development of the Gilpatrick Mine. No production has been recorded from this deposit, although small quantities of ore may have been processed by the Gilpatrick Mine owners. Trenching and pitting have occurred at the southeast and northwest ends of the vein.

Geologic Setting

Mineralization consists of a quartz-carbonate vein averaging 12 to 14 in thick over a strike length of at least 235 ft. The vein strikes N30°W and dips steeply to the northeast. The quartz is locally vuggy and contains galena, arsenopyrite, sphalerite, pyrite, and gold. Free gold is present and can be panned from crushed quartz. The host rock is Valdez Group slate and graywacke and shows considerable folding in the area. Axial plane cleavage strikes N20°E and dips vertically. Bedding is locally apparent with north to northeast strikes and variable dips from 0 to 90° where it has been dragged along longitudinal faults striking N20°E.

Bureau Work

Surface sampling was done in 1980 and 1981. Ten samples (4781-4782, 4784-4787, 5650-5652, and 5683) collected by the Bureau contained up to 5.15 oz/st Au and 3.5 oz/st Ag (appendix). The sample locations are shown on figure 23. Grades appear to be highest on the northwest end of the vein and to diminish to the southeast.

Resource Assessment

Based upon surface sampling, an identified resource of 3,400 st with a weighted-average grade of 2.4 oz/st Au and 1.6 oz/st Ag occurs at this deposit. This estimate is based upon a strike length of 260 ft, a thickness of 1.2 ft, a depth of 130 ft, and a tonnage factor of 12. This deposit could easily be developed in conjunction with veins located at the Gilpatrick Mine. The Summit Vein prospect has high mineral development potential. Additional exploration, including surface trenching and sampling and detailed mapping, is warranted.

Heaston-Oracle Mine

The Heaston-Oracle Mine is on Summit Creek about 1 mile west of the Seward Highway between elevations of 1,800 and 3,500 ft (figs. 22-25).

History and Production

Robert B. Heaston discovered the Heaston-Oracle Vein in 1921 (*48*) and completed minor development work between 1921 and 1929, when the mill site and two claims

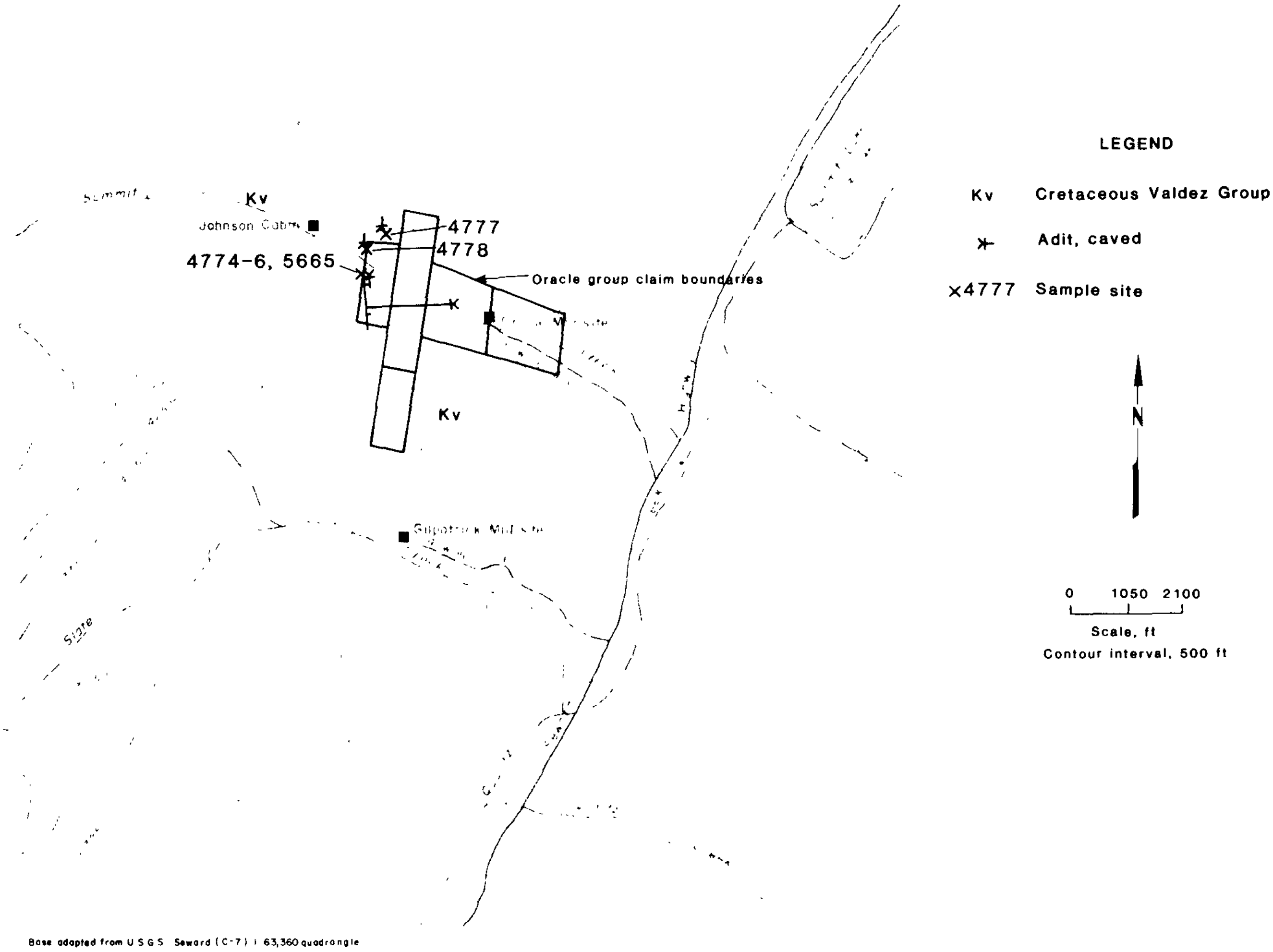


FIGURE 25.—Sample location map for Oracle Mine.

were patented. The Alaska Oracle Corp. was established in 1930 and commenced extensive development work and construction of a mill. Minor production and considerable sampling were completed in 1931. Ralph Reed optioned the property in 1935, continued development work, and constructed a new mill. Production records are incomplete, but apparently production occurred during 1921 to 1922, 1937 to 1941, and again in the late 1940's to early 1950's. Total recorded production was 1,274 oz Au and 256 oz Ag, with grades averaging between 1 and 2 oz/st Au.

Operating Data

The main workings consist of a 900-ft crosscut, 550 ft of drift, 215 ft of raise, 25 ft of winze, and considerable stoping (*34*). Two caved portals, one on the north side of the creek at 1,800 ft above sea level, 200 ft west of the mill, and the other on the south side of the creek at 1,900 ft above sea level, 1,000 ft west of the mill, were used to access the workings.

Figure 26 consists of plan and cross-sectional views of the workings compiled from a company mine map prepared by George Nelson (*34*) in 1931 and development descriptions by Roehm (*42, 48*) and Tuck (*65*). Several hundred feet of workings on the northern extension of the vein occur on the north side of Summit Creek across from the caved portal to the 1,900-ft level, at elevations between 2,000 and 2,400 ft. The portals are caved, so none of these adits could be investigated. Additional prospect pits and trenching occur on the south side of the creek at elevations as high as 3,500 ft. The property can be reached from the Seward Highway via an unmaintained mine road which was washed out completely several hundred feet east of the mill site.

Geologic Setting

The Heaston-Oracle Vein is hosted by Valdez Group metasediments. Tuck (*65*) described the geology and mineralogy of the vein as follows:

> The vein strikes N15°E and has an average dip of 60°W. In width it ranges from a few inches to 3 feet, with an average of about 12 to 14-inches over a length of 175 feet on the lower level. The country rock is interbedded slate and graywacke, in which the bedding is usually very obscure on account of the gradation in texture of the slate to

the graywacke. The finer textured phases possess good cleavage, which has a general strike of N15°E and dips ranging from 60°W to 80°E. In a few places where the bedding could be distinguished it is parallel to the cleavage. The graywacke is usually very massive, with only scattered joints.

The vein occupies a fracture along which movement has taken place prior to ore deposition. This fracture in general parallels the structure of the graywacke and slate but here and there deviates from it, so that as a result of the movement along the fracture there is in some places a footwall of graywacke and a hanging wall of slate. It has been thought that these walls determine the position of the vein and that the vein formed at the contact of the slate and graywacke; but this is only a coincidence: the position of the vein was determined by the fracture. As shown by both the upper and the lower levels, the south end of the vein takes a flat roll into the footwall, and in the development work this roll was not followed out. The position of the roll on both levels and the development in the north end of the lower level, where the ore pinches out, suggest that the ore shoot has a rake of 20°-45°SE. Whether the ore feathers out or continues at the point where it takes the flat roll remains to be proved by further development work.

Slickensides and grooves having the same rake as the ore body were observed on the lower level. On both upper and lower levels footwall stringers are common, particularly in the massive graywacke. These stringers or gash veins have the appearance of quartz-filled tension fractures, and their position confirms the impression gained from the fault surfaces that the premineral movement was such that the hanging wall moved to the ore shoot.

Not all the movement occurred prior to the mineralization, as is shown by the slickensided and sheared quartz. The postmineral movement has been in general parallel or closely parallel to the vein, as no transverse faults were observed. The weathering of the vein material has proceeded to depths of 50 to 75 feet below the surface, so that the quartz is very friable and iron-stained.

The minerals contained are arsenopyrite, pyrite, galena, and sphalerite, named in decreasing order of abundance, but in total they probably form only 0.5 percent of the ore. The gangue mineral is chiefly quartz with small amounts of calcite. The pyrite is usually well crystallized and commonly impregnates the wall rock for a few inches. The galena is fine grained and is disseminated in the quartz. The arsenopyrite is commonly euhedral and as a rule is confined to fractures in the quartz. The sphalerite is very scant and is of the ferruginous variety. Chalcopyrite, pyrrhotite, and molybdenite have also been reported. Gold occurs both free and with sulfides. Free gold is difficult to find in hand specimens, as it is apparently very fine.

Bureau Work

Surface sampling was done in 1980 and 1981. Quantitative data available for six samples (4774-4778 and 5665) collected from the Heaston-Oracle Mine by Bureau crews are listed in the appendix. The sample locations are shown in figures 25 and 26. Sample 4774, a chip sample collected across an 8-in-thick exposure above the collapsed 1,900-ft portal on the south side of Summit Creek, assayed 1.64 oz/st Au and 0.71 oz/st Ag. Selected samples of the vein were found to contain visible specks of gold, generally less than 0.03 in diameter, as well as arsenopyrite, pyrite, galena, sphalerite, molybdenite, and minor chalcopyrite.

Resource Assessment

Extensive sampling of the vein in the 1,800- and 1,900-ft levels (fig. 26) by the Alaska Oracle Corp. in 1930 indicated that values averaged approximately 2 oz/st Au over a vein length of 150 ft, a depth of 110 ft, and a thickness of 14 in (*34*). Considerable stoping is reported to have occurred between the two levels during the 1937-41 production period, which likely resulted in the removal of the majority of those resources. However, there is no information indicating that the portion of the ore shoot which reportedly continues below the 1,800-ft level was ever developed.

Based upon recorded mine history, the indicated grade of the vein, and possible continuation of the vein at depth, additional evaluation of the property appears to be warranted. In 1984, the crosscut was reopened to allow systematic sampling of the remaining vein exposed in the old workings. Drilling is needed to ascertain whether the vein continues at depth and to evaluate the characteristics of the host rocks. Further development should include the sinking of a shaft (inclined or vertical) in order to gain access to and develop lower levels on the vein. However, the extreme avalanche hazard near the current surface exposure of the vein should be considered prior to development activities. Avalanches probably accounted for use of the 900-ft crosscut to reach the vein, since this access allowed the portal to be located near the mill, where the least avalanche hazard exists. This deposit has high mineral development potential.

Hirshey-Lucky Strike Mine

This mine is near the head of Palmer Creek. The mill site is at an elevation of 2,200 ft, on the east side of the creek; and the workings are at an elevation between 3,200 and 3,400 ft, 0.75 mile south of the mill (fig. 22).

History and Production

John Hirshey originally discovered the deposit in 1911. He operated the mine from 1911 through 1921 using a 1-stamp mill (*47*). The Alaska Mining Co. purchased the mine in 1922, constructed a road from Hope to the mine, and installed a 5-stamp mill with a jaw crusher, wilfley table, and amalgamation plates. Following several years of production, the mine reverted to Hirshey in 1927 (*47*). Sporadic production occurred under his management through 1939. A cyanide plant was installed to rework the tailings in 1931, but the venture proved unprofitable (*65*). No development work has occurred since 1940. Total recorded production is 6,094 oz Au and 4,699 oz Ag from 6,310 st of ore (table 12). Production records may be incomplete.

Operating Data

Three working levels at elevations of 3,200, 3,300, and 3,400 ft were used to develop the mine. Currently, all levels are mostly inaccessible due to caving and/or icing conditions

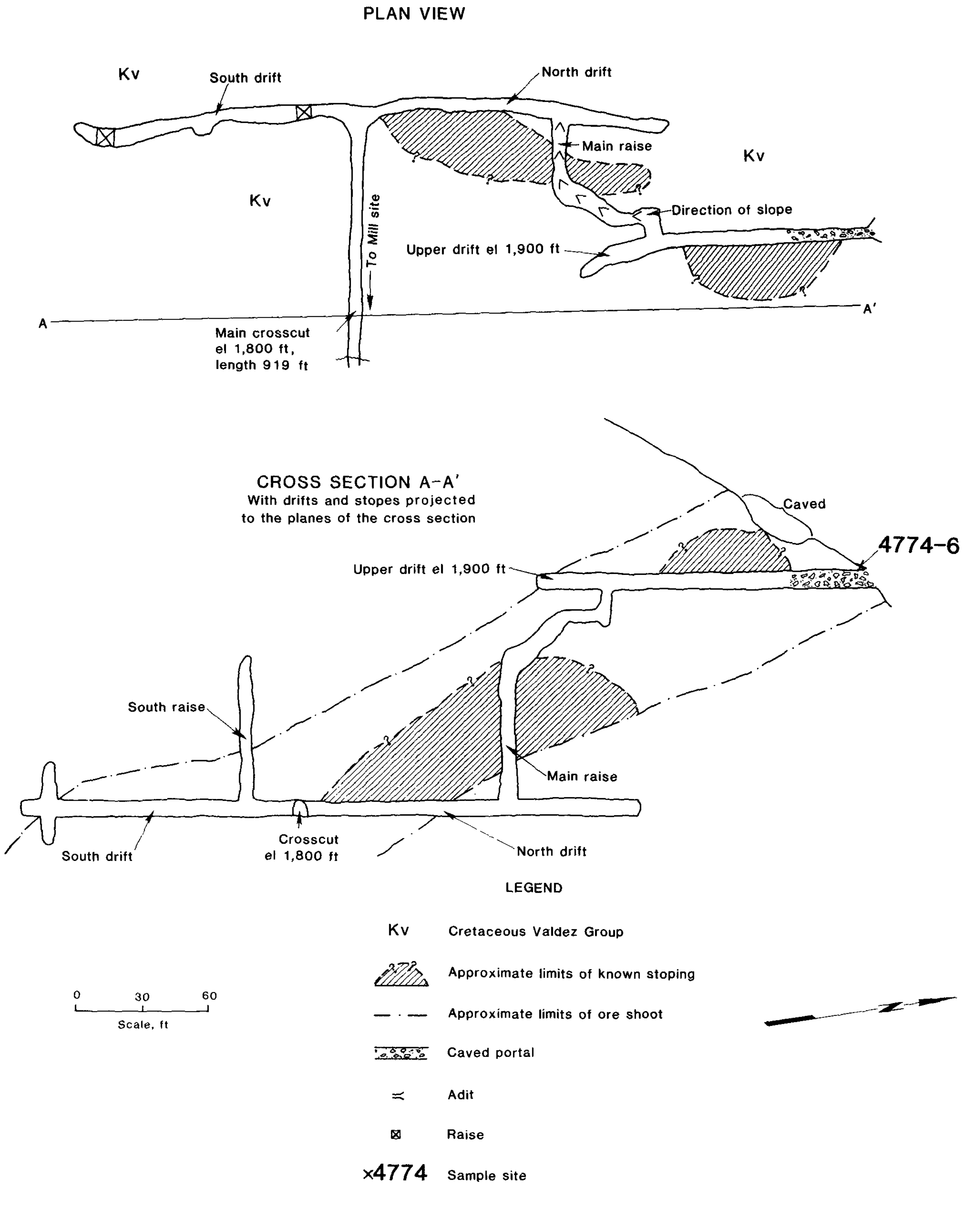


FIGURE 26.—Map of Oracle Mine workings.

Table 12.—Recorded gold-silver production from Hirshey-Lucky Strike Mine

Year	Ore, st	Recovery, oz	
		Au	Ag
1914	38	394	10
1915	95	361	NA
1916	30	94	4
1917	40	133	55
1918	50	139	100
1919	55	335	186
1920	55	169	131
1921	150	345	276
1922	[e]300	643	514
1923	[e]250	218	1,829
1924	[e]800	761	906
1925	[e]120	114	65
1926	[e]314	212	78
1928	450	328	94
1929	[e]746	746	186
1930	[e]600	307	112
1931	934	412	100
1932	800	145	NA
1933	NA	105	NA
1934	NA	2	NA
1935	212	29	12
1936	84	28	11
1938	150	65	24
1939	37	9	6
Total	6,310	6,094	4,699

[e]Estimate. NA Not available.

which occur within a few feet of the portals. Figure 27 is a sketch of the mine workings as they existed in 1931 (*65*).

Tuck (*65*) described the mine in 1931 as follows:

> The underground workings consist of three levels at vertical intervals of 100 feet. At the present time the upper tunnel, which lies about 30 feet below the discovery, has caved to a point within 30 feet of the portal, and therefore the greater part is inaccessible. The middle tunnel, about 500 feet in length, is in good condition and is used only for ventilation and safety, as practically all of the ground between the upper and middle levels has been stoped. The lower tunnel is the present working tunnel, and nearly all of the ground above it has been stoped. The underground work at present consists of development on the east face of the lower level and the stoping of the few remaining blocks above it.

Geologic Setting

The country rock is Valdez Group slate, the cleavage of which has a strike ranging from north to N35°E, with a dip of 60° to 80°E. Near the surface, the slate may show an inclination as low as 40°E, owing to surface creep. Bedding in the slate was not visible underground. The only place bedding was observed was at the portal of the lower tunnel, where it had been accented by weathering. It was folded at that location, but in general was horizontal to gently dipping.

Tuck (*65*) discussed the geologic setting in detail:

> The vein occurs in a curving and branching fracture that cuts across the cleavage of the slate at approximately right angles, so that the strike of the vein ranges from N45°W to west. The dip of the vein ranges from 20°N on the west end of the middle level to 75°NE on the east end. The average inclination is about 40°N. The width of the vein ranges from a few inches to 5 ft, with an average of about 18 inches. On the lower level the vein is about 300 feet long, but it is not all minable. On the middle level it is about 350 feet long, but here also it is not all ore. The stoping length on both the lower and middle levels is about 200 feet. Measurements on the upper level were not available, but it is probable that the length was somewhat less, owing to the slope of the hill, as on the upper level the vein crops out and a portion has been eroded, whereas, on the lower level and probably also the middle level the vein pinches out before reaching the surface. This is due not only to the slope of the hill but also to the fact that the ore shoot rakes to the northeast. On both the middle and the lower levels the vein curves, and the apex of the curve occurs in the middle of the shoot, so that structurally it has the appearance of a plunging nose. This curvature appears to increase in depth, and it is probable that the vein may split into two, there is a suggestion of this on the lower level, where the vein splits at the apex of the curve. On the dip of the vein developments have proved a distance of 350 feet, with ore still showing in the bottom of the lower level. Vertically, this means a proved depth of about 250 feet.
>
> Associated with the vein is considerable gouge, sheared slate, and in a few places a vein breccia. Considerable postmineral movement has taken place, but this has been in the nature of small faults parallel to the vein, which have sheared the vein material, forming considerable gouge between the vein and the country rock, and at places have sheared the slate as well as the quartz. In a few places the movement has caused slicing in the vein closely parallel to the walls, giving it a greater width, but elsewhere it has caused pinching, making the vein exceedingly difficult to follow and greatly increasing the cost of the development. The walls are usually well-defined, and the ore breaks clean from them. In a few places both footwall and hangingwall stringers are abundant. In several places irregular masses of what appears to be a different quartz intercept the veins and increase the cost of development, as they carry little gold.
>
> The mineralogy of the vein is typical of the district. The vein material consists chiefly of quartz with small amounts of calcite and ankerite. The metallic minerals, in order of abundance, are arsenopyrite, pyrite, galena, sphalerite, and free gold with the arsenopyrite greatly in excess of the others. The proportion of sulfides to vein quartz varies greatly from place to place, ranging from a fraction of 1 pct to as much as 20 percent, the average being about 2 percent. The gold occurs both free and combined with the sulfides, but there does not seem to be any direct relation between the amount of the sulfides and gold—in fact, the richer portions of the vein have the smaller percentage of sulfides.
>
> The gold is almost entirely in the vein material. In some of the richer portions of the vein the wallrock may carry some gold but in general not enough to warrant mining. Assays are as high as several hundred dollars to the ton and usually are highest where the vein has a width of 6 to 12 inches. It has been said that the upper level and

> the discovery cut contained very rich ore, portions of which averaged several hundred dollars to the ton. It was rich enough to make a profit with a 1-stamp mill before a road was put into the district, when handling of the ore several times from the mine to the mill was necessary. It is probable that the ore mined from the lower level averages around $40 a ton, although portions running much less than this have been unstoped. In a few places where the footwall stringers are abundant $3 to $5 channel samples have been obtained from 4 ft wide widths of quartz stringers and slate. As elsewhere, the mineralization has been erratic, and close sampling is necessary, although in general the oxidized and sheared quartz, which can be easily identified with the eye, is found to carry the most gold.

Figure 5 is a photograph of the Lucky Strike vein where it is exposed in a small raise located in the upper level. The vein is banded in appearance, 18 in thick, and strikes east-west with a dip of 60° to the north. Assays exceeding 1 oz/st Au have been collected from this location by the USGS (*29, 65-66*); Roehm (*47*), of the Alaska Territorial Department of Mines; and the Bureau (samples 5639-5643).

Bureau Work

During 1981, the Bureau sampled the accessible portions of the lower and upper levels of the mine (fig. 27). Five samples (5639-5643) contained up to 99 ppm Au and 65 ppm Ag (appendix).

Resource Assessment

An identified resource of 2,100 st with a weighted-average grade of 1.25 oz/st Au and 0.65 oz/st Ag occurs between the lower and upper levels of the mine. This estimate was made using a strike length of 75 ft, a thickness of 1.1 ft, a known depth of 300 ft, and a tonnage factor of 12. Due to the inaccessibility of the workings, it was not possible to obtain meaningful estimates of the mineral resources remaining in the mine. Based upon Tuck's description (*65*), it appears unlikely that significant tonnages of high-grade ore are accessible from existing workings. However, Tuck (*65*) pointed out that

> The mineral associations would suggest that there is an excellent chance of continuation in depth if suitable structural conditions exist. The fractures in the district are as a rule very erratic and do not persist over any great length or depth, although in general the depth exceeds the length.

A drilling program would be required to test the possibility of an extension at depth. Mineralization of lower grade (less than 0.3 oz/st Au) may not have been stoped and could exist in the current workings. The deposit has high mineral development potential.

Nearhouse Mine

The Nearhouse Mine is on the south side of the divide between Palmer and Bear Creeks at elevations between 2,800 and 3,100 ft (fig. 22).

History and Production

This property was discovered by I. Nearhouse in 1925 (*49*). The first reference to this property in the literature was by Tuck (*65*) in 1931. He reported that considerable prospecting of the vein had preceded his visit. J. D. Bazard optioned the property in 1935 and formed the Gold Mint Mining Co. (*49*). Some development occurred over the next few years. The property was optioned by Dwight Whiting and Carl Beal in 1940 for $35,000 (*42*). Roehm (*42*) reported that a bunkhouse, shed, and 200 ft of drifting were constructed in 1941. An estimated 3,000 st of mineralized material has been removed from the mine. This material should have averaged 0.5 oz/st Au and up to 1 oz/st Ag, based upon early assays. However, total recorded production was 102 oz Au and 3 oz Ag from 22 st of ore mined from 1937 to 1939.

Operating Data

A partially overgrown trail leads from Palmer Creek Road to a collapsed building at an elevation of 2,800 ft. A 35-ft adit and a 450-ft adit with an 80-ft winze occur at elevations of 3,050 ft and 3,100 ft, respectively (fig. 28). Some equipment, including a compressor, remains on the site. Dynamite and caps have been left in the west drift of the 3,100-ft level.

Geologic Setting

The Nearhouse vein is hosted by Valdez Group rocks consisting of well-bedded, slightly metamorphosed siltstone and sandstone with a strike of N15°E and a dip of 60°W at the portal of the 3,100-ft level. These rocks contain abundant sedimentary features, suggesting that the bedding is overturned. Felsic dikes occur nearby on the surface, and one was intercepted in the east drift.

The mineralization consists of a banded and brecciated quartz vein averaging 20 in thick along the developed portion of the drift. The vein strikes N50° to 80°W and dips 60° to 90°N. The banding is dark gray and is believed to be carbonaceous material. Metallic minerals include small amounts of arsenopyrite, galena, sphalerite, pyrite, and gold, collectively making up less than 0.5 pct of the vein material. The vein is cut off at both ends by transverse (left-lateral) faults. However, the vein has good continuity to the surface and to a depth of over 80 ft in the winze.

Bureau Work

Surface and subsurface sampling and some mapping in conjunction with USGS personnel were done in 1980 and 1981. Twenty-four samples (4436, 4755-4769, 5610, and 5801-5807) contained up to 15 ppm Au and 0.5 oz/st Ag (appendix). The locations for samples collected in the 3,050- and 3,100-ft levels are shown on figure 28.

Resource Assessment

An identified resource of 6,400 st grading 0.2 oz/st Au and 0.3 oz/st Ag occurs at the Nearhouse Mine. This estimate is based upon a strike length of 250 ft, a thickness of 1.7 ft, a known depth of 180 ft, and a tonnage factor of 12. The average grade is low, but potential for additional resources in the area exists. The Nearhouse Mine has moderate mineral development potential. Additional work is recommended, including geologic mapping at a large scale, surface trenching, sampling, and drilling.

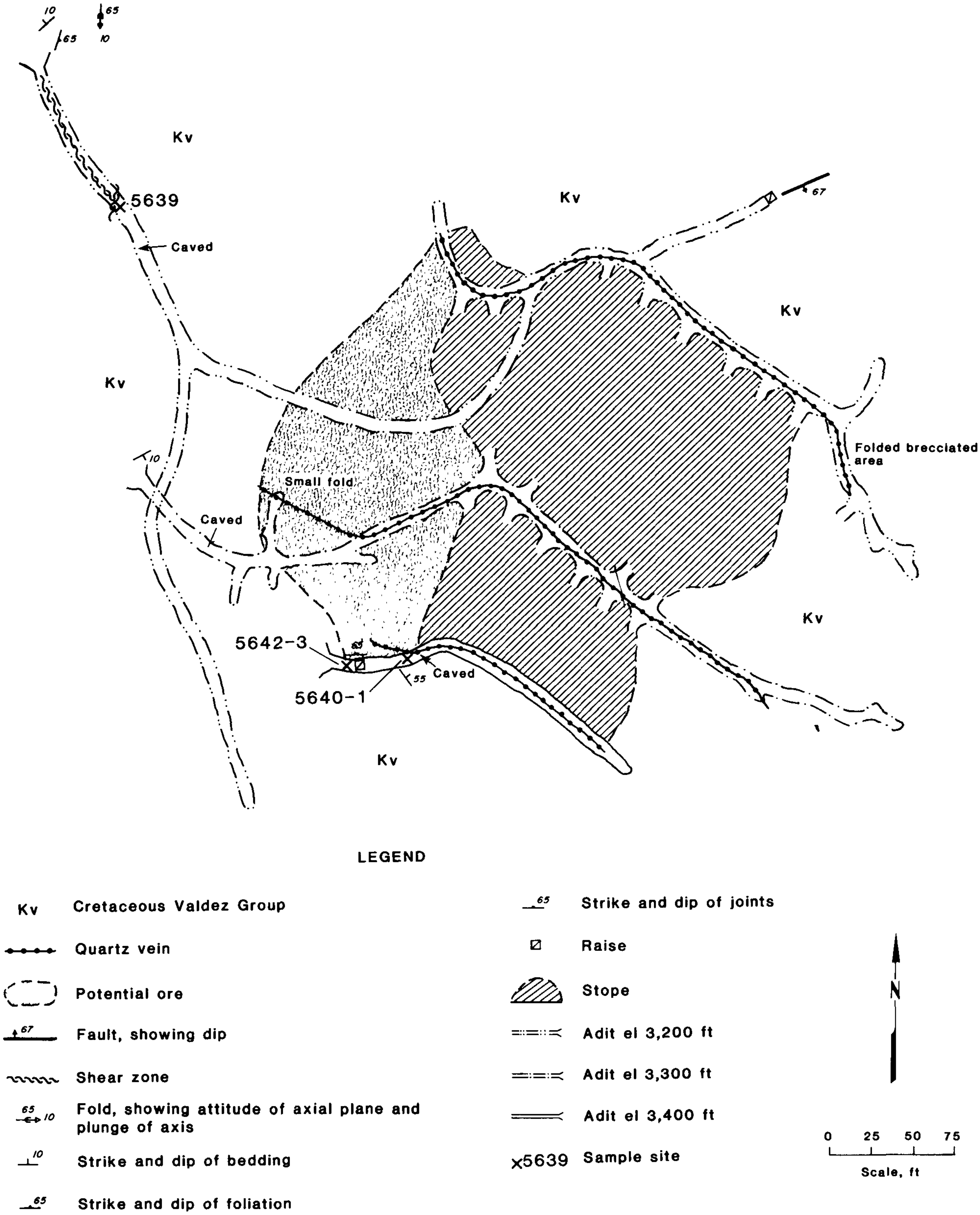


FIGURE 27.—Sample locations map for Hirshey-Lucky Strike Mine.

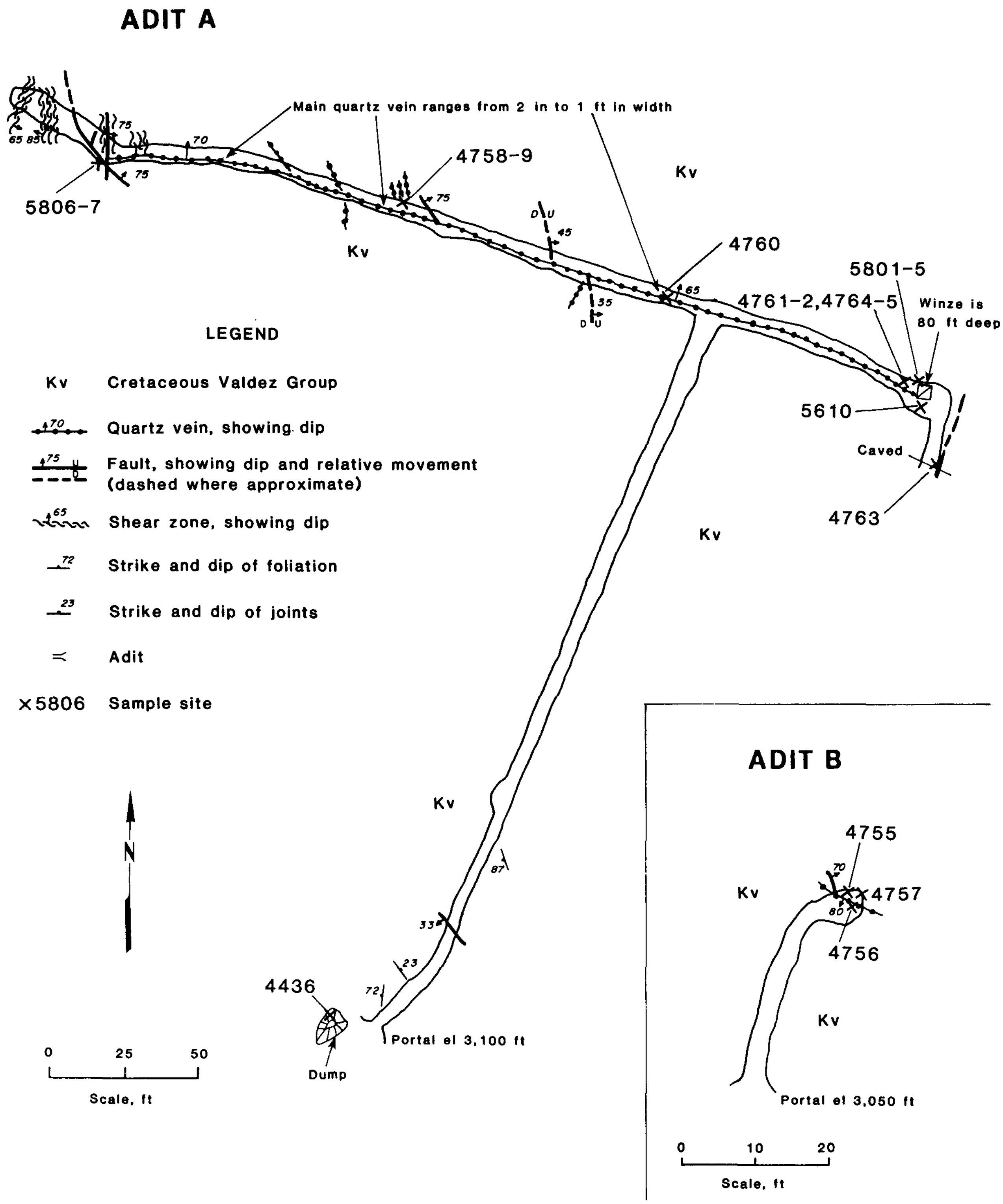


FIGURE 28.—Sample location map for Nearhouse Mine.

Mineralized Dikes

The only intrusive rocks in the Summit Lake-Palmer Creek area are fine-grained felsic dikes that parallel foliation in the Valdez Group but are locally discordant to both foliation and bedding. Potassium-argon ages of approximately 53 m.y. were obtained from two hydrothermally altered and mineralized dikes in the Summit Lake-Palmer Creek area (*30*). These dikes are typically narrow, averaging less than 4 ft thick, but have been traced for distances up to 11 miles along strike.

Fresh samples of these dikes appear greenish in hand specimen. They tend to become buff-colored upon weathering and spotted with hematite or limonite stains due to weathering of contained iron sulfides.

Compositionally the dikes are either tonalite, granodiorite, or alkali granite (*30*). Plagioclase feldspar is the most common constituent, followed by quartz, chlorite, and calcite. The quartz occurs as a primary mineral, and additional quartz has also been introduced along with calcite as veins and replacement masses (*65*). Portions of the dikes contain arsenopyrite. Galena, sphalerite, pyrite, chalcopyrite, stibnite, and gold occur locally in the secondary quartz-carbonate veins and replacement masses.

The Gilpatrick and Palmer Creek dikes deserve further discussion because of their potential for providing large-tonnage, low-grade resources and locally high-grade mineralization.

Gilpatrick Dike

The Gilpatrick dike can be traced for 11 miles from Slate Creek on the south to Donaldson Creek on the north (fig. 22). The average width is estimated to be 6 ft, but the width is known to exceed 15 ft locally. The dike is most exposed at the Gilpatrick Mine, on the divide between Summit and Colorado Creek, and on the divide between Pass and Frenchy Creeks.

The Gilpatrick dike is hosted by Valdez Group rocks and is highly fractured with locally occurring mineralized quartz-carbonate veins up to 8 in thick in the fractures. These veins contain arsenopyrite, pyrite, galena, sphalerite, and gold. Deposits developed along the dike include the Gilpatrick Mine and the Colorado, Shell, and Gilpatrick prospects (fig. 22). Of these, only the Gilpatrick Mine has recorded production.

Data from 16 samples of mineralized dike rock and nearby quartz veins collected from the Colorado, Shell, and Gilpatrick prospects are included in the appendix. Samples collected from the Shell prospect, containing up to 10.7 ppm Au and 13 ppm Ag, are not representative of the dike; they reflect the presence of adjacent locally higher grade gold-quartz veins. Similarly, a grab sample of mineralized quartz (4788) containing 14.5 ppm Au and 830 ppm Ag, collected from the dump of the Gilpatrick prospect, reflects the presence of locally high-grade mineralization but is not representative of the dike as a whole. Three samples of dike rock (4413, 5682 A, and 5682B) collected at the Gilpatrick prospect contained up to 0.66 ppm Au and 7.4 ppm Ag. Although the grades of the dike are low, the potential tonnage is high. The Gilpatrick dike is estimated to contain an identified resource of 14 million st grading 0.02 oz/st Au and 0.2 oz/st Ag. This estimate is based upon a strike length of 56,000 ft, a thickness of 6 ft, a depth of 500 ft, and a tonnage factor of 12. The Gilpatrick dike has low to moderate mineral development potential as a large-tonnage, low-grade gold-silver mine.

Palmer Creek Dike

The Palmer Creek dike can be traced for a distance of 6 miles from the Palmer Creek Glacier on the south to the headwaters of Cub Creek on the north (fig. 22). This dike is most exposed in the vicinity of the Teddy Bear and Kenai Star prospects and along the hill slope between the two deposits (fig. 22).

The dike strikes N15 °E and dips 65 °SE in Valdez Group slate and graywacke. Its average thickness is estimated to be 3 ft, but locally the dike is more than 8 ft thick. The dike rock is highly fractured, with numerous quartz-carbonate veins up to 6 in thick occupying the fractures. Arsenopyrite, chalcopyrite, galena, sphalerite, and minor gold are present in the quartz-carbonate vein fracture fillings.

Several deposits are spatially related to the dike. These include the Hirshey-Lucky Strike Mine and the Teddy Bear and Kenai Star prospects (fig. 22). Of these, the Hirshey-Lucky Strike Mine was a notable gold and silver producer with high-grade quartz ore. Six samples collected from the Teddy Bear (4431 and 7156) and Kenai Star (4433-4435 and 4451) prospects contain up to 5.1 ppm Au and 2.2 ppm Ag (appendix).

The Palmer Creek Dike contains an identified resource of 4 million st with an estimated grade of 0.03 oz/st Au and 0.07 oz/st Ag. This estimate is based upon a strike length of 32,000 ft, a thickness of 3 ft, a cutoff depth of 500 ft, and a tonnage factor of 12. Although the grade is low, the potential tonnage is high. The Palmer Creek dike has low to moderate mineral development potential as a large-tonnage, low-grade, gold-silver mine.

GIRDWOOD AREA

Six lode gold deposits have been identified in the Girdwood area. Five of these have had recorded production. Two deposits, the Monarch and Jewel mines, are discussed below because of their significant past production and high mineral development potential. The other deposits are summarized in a previous report (*18*).

Monarch Mine

The Monarch Mine is approximately 8 miles from Girdwood near the head and on the east side of Crow Creek valley at elevations between 2,880 and 3,550 ft (fig. 29).

History and Production

Conrad Hores originally discovered this deposit in 1909. Considerable development work, which resulted in only minor production, occurred from 1910 to 1912. Clyde Brenner relocated the property and transferred it to the Crow Creek Mining Co. in 1926 (*64*). H. I. Staser leased the property from the Crow Creek Mining Co. in 1928 but reassigned the property to the Crow Creek Mining Co. the same year. Minor production occurred in 1926 and 1928 using a 1-stamp mill, small crusher, and amalgamation plate. The Bruno Augustino Mining Co. leased the property in 1931 and commenced mining and development work, including the installation of a larger mill utilizing hydropower and three tram lines (*37*). Production began in 1933 and continued through 1941 with only a limited quantity of gold being produced subsequent to the mine's closure during the World War II. The mill has burned, so no equipment of value remains on the site. Total recorded production, including that of the Jewel Mine, was 4,933 oz Au and 996 oz Ag (table 13).

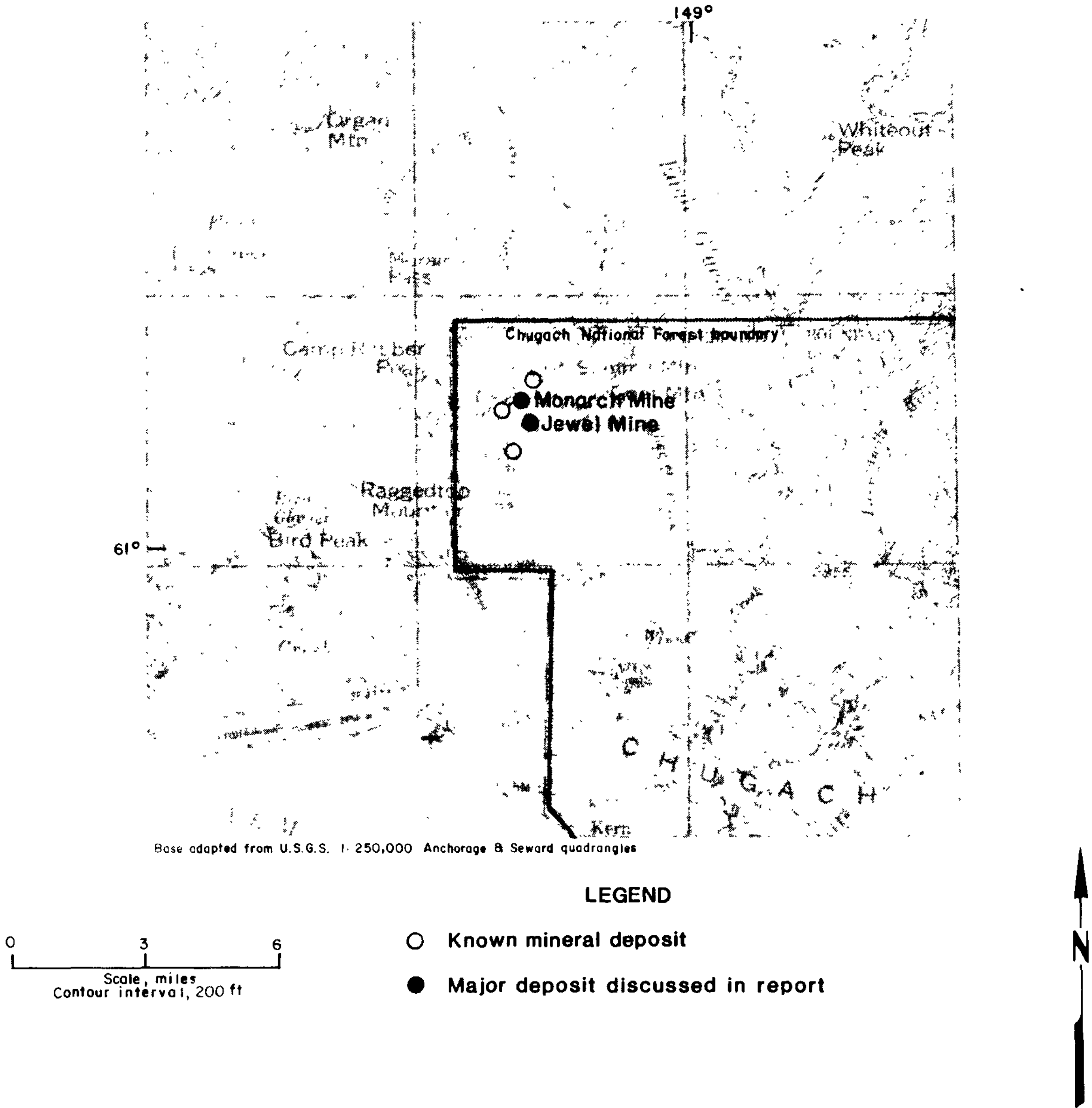


FIGURE 29.—Locations of important lode gold deposits in Girdwood area.

Table 13.—Recorded gold-silver production from Monarch and Jewel Mines

Year	Ore, st	Recovery, oz	
		Au	Ag
1909-12	NA	Minor	Minor
1926	NA	66	NA
1928	NA	67	NA
1933	NA	209	NA
1934	NA	917	5
1935	NA	1,160	221
1936	915	709	184
1937	1,247	621	234
1938	512	268	117
1939	290	105	47
1940	321	236	108
1941	184	536	59
1942	20	8	5
1945	12	8	4
1947	27	23	12
Total	[1]3,528	4,933	996

NA Not available. [1]Since 1935.

Operating Data

The Monarch Mine was developed on two westerly striking, north-dipping, subparallel veins referred to as the north and south veins. Development in 1937 was reported (*50*) to have consisted of 950 ft of drift, 125 ft of crosscuts, 52 ft of winze, and 4 raises aggregating 100 ft (fig. 30). The south vein is developed by two levels at elevations of 3,200 and 3,300 ft. The lower level is open to the face. The upper level is caved at the portal but can be entered through a stope that intersects the surface. The north vein was developed on two levels, at 3,285 and 3,420 ft, both of which are badly caved. A 60-ft-long adit was developed about 500 ft north of the north vein at an elevation of 3,500 ft to examine a north-striking molybdenum-chalcopyrite-bearing vein. This vein can be traced from the portal of the south vein about 750 ft north-northeast to the portal of the 60-ft-long adit (fig. 31). Most of the stoping and production appears to have come from the upper level on the south vein.

Roehm (*50*) described the mill equipment and operation as it existed in 1937 as follows:

> The mill machinery consists of a Wheeling jaw crusher, 15-ton Denver quartz mill with inside amalgamation, 40-mesh screens, a 5 × 5-foot amalgam plate, three-quarter size Straub concentrating table. Contained in the same building is an Ingersoll-Rand single compressor, 12 × 14 inches. Both mill and compressor are run by a 5-foot Pelton wheel with a 153-foot head. 420 feet of pipe line and several hundred feet of flume lead the water to the Pelton, located on the side of the mill building. A 10-hp Fairbanks Morse gasoline engine is used for auxiliary power. A small air hoist is used on the tram to the Monarch. Three aerial trams are used, two 1500-foot trams to the Monarch north and south veins, and a new 2500-foot tram to the Jewell Mine. A new tractotrac, 20-hp, and a Chevrolet truck comprise the transportation equipment. An Ingersoll-Rand steel sharpener is used in the blacksmith shop. A combined mill, power, and blacksmith shop are contained in one structure, and a cook house, bunk house and an ore bin and storage structure—the latter at the portals of the two mines, comprise the buildings. A total of five men were employed this season, and the operating season extends from the middle of May until the middle of October.

Geologic Setting

The host rock in the vicinity of the Monarch Mine consists of contact metamorphosed Valdez Group rocks intruded by felsic dikes and a granitic stock that is exposed 0.25 mile east of the mine. Foliation dips steeply and strikes north-northeast. Bedding, where discernible, varies in attitude, and the rocks are extensively fractured. These structural complications were apparently created by intrusion of the stock. The bedding, which is near the mine, strikes west and dips 40°N. Two sets of faults occur in the mine area. In west-striking set of faults, the faults are usually occupied by highly fractured gold-bearing quartz bounded on one or both sides by 0.5 to 3 in of gouge, indicating that some of the deformation postdated the mineralization. The adjacent wall rocks are highly shattered, are commonly greenish in appearance due to the presence of chlorite, and contain considerable pyrite and occasional anomalous precious metal values. The older, north-striking set of faults hosts molybdenite-chalcopyrite-bearing quartz veins with less gouge along the walls. Park (*37*) described the two veins developed at the Monarch Mine and the crosscutting veins as follows:

> The south vein ranges in width from 6 inches to about 4 feet, with an average of 9 inches in the tunnel. The strike is from east to S80°E, and the dip is 55°-70°N. The gangue is either massive or sugary quartz. In some places the vein splits into several nearly parallel stringers, separated by gangue or by sheared and partly oxidized wall rock. The quartz is commonly stained with limonite, and in places scattered spots of sulfides are visible. Many fragments of country rock are isolated in the quartz.
>
> The north vein strikes about N80°E and dips about 70°N. Where exposed in the tunnel and in several surface cuts it is from 10 inches to 3 feet wide, with an average of 1 foot. The north vein appears to be somewhat better defined than the south vein and may be traced farther on the surface.
>
> There are several small crosscutting veins 6 inches wide that strike a few degrees west of north and dip either east or west. These crosscutting veins appear to be faulted, and in the lower adit of the old workings the strike swings from due north to N45°E. The small veins striking north appear to be slightly older than the main north vein, as they are offset along unbroken quartz in the north vein. The junctions of the crosscutting veins with the south vein have not been seen, as they are obscured by a rock slide. The crosscutting veins of the north-south system are very persistent for this district, and one mineralized veinlet 6 to 8 inches wide was followed for more than 500 feet.

Minerals identified in the above described veins include quartz of at least two generations, calcite, galena, chalcopyrite, sphalerite, arsenopyrite, pyrrhotite, molybdenite, and gold. Park (*37*) reported collecting a sample from one of the crosscutting veins that contained 0.26 pct Mo. Several samples collected from similar veins in 1981 contained up to 600 ppm Mo, usually in association with chalcopyrite. Alteration products include limonite, cerusite, and abundant scorodite where arsenopyrite is prominent.

Bureau Work

Extensive sampling and some surface mapping of the Monarch property was done in 1981 and 1982. Subsurface samples were collected where possible, but most of the workings are inaccessible (figs. 30-31). Forty-three samples collected at the Monarch Mine (5473-5481, 5552-5557, 5611-5638, and 5755) contained up to 234 ppm Au and 92 ppm Ag (appendix). Two sets of mineralized veins were identified on the property. The north and south veins, which strike westerly and contain gold values, make up one set, and north to northeasterly striking veins containing chalcopyrite and molybdenite with little or no gold values make up the second set.

Resource Assessment

An estimate of the possible resources of this deposit was not made because of the inaccessible nature of the work-

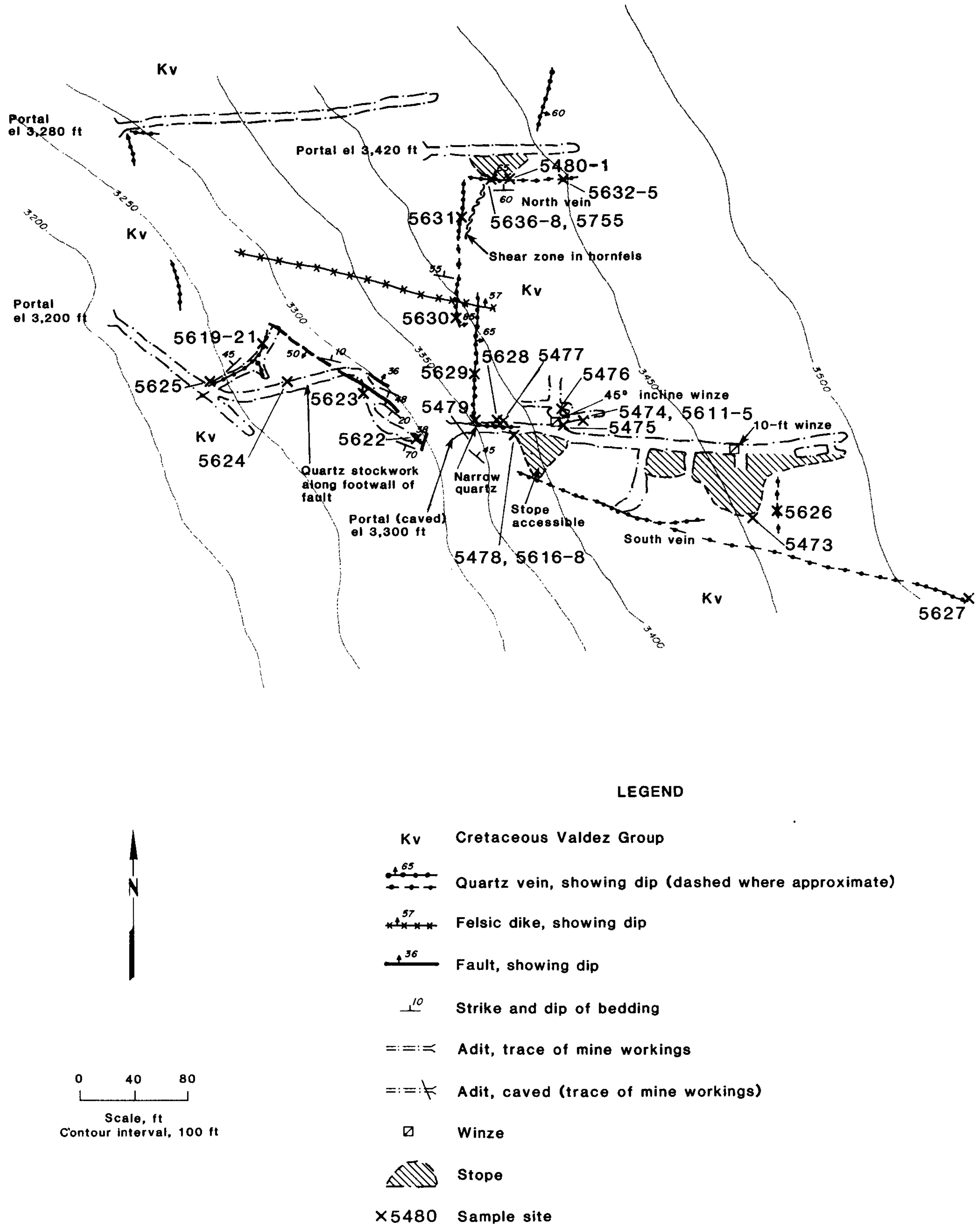


FIGURE 30.—Sample location map for Monarch Mine.

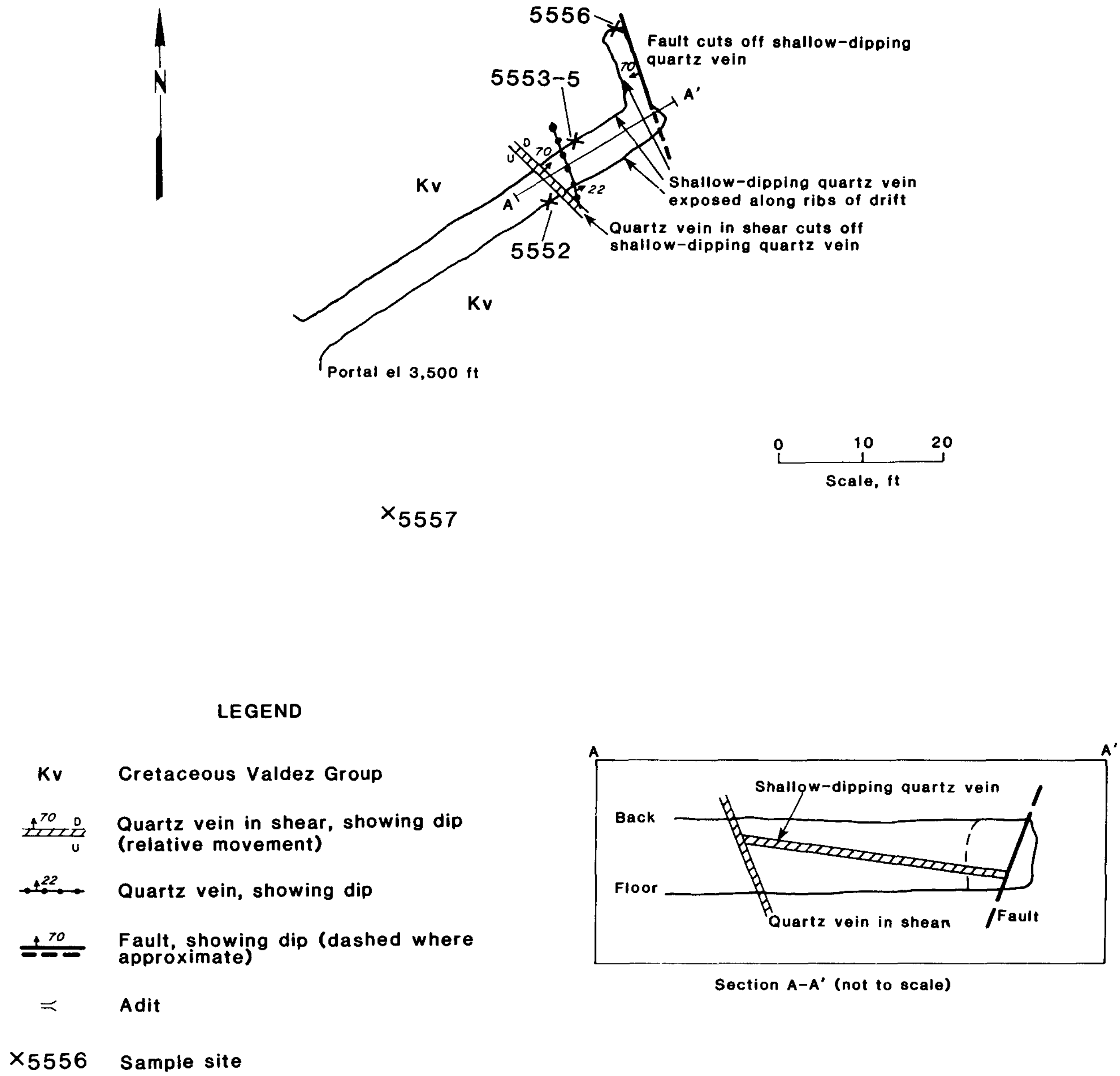


FIGURE 31.—Sample location map for 3,500-ft level of Monarch Mine.

ings. However, a down-dip extension of the south vein is likely, as is the strike extension of the north vein. Additional exploration, including surface trenching and sampling and geologic mapping, appears to be warranted on both veins. This deposit has high mineral development potential based upon its production history and Bureau sampling.

Jewel Mine

The Jewel Mine is 8 miles from Girdwood near the head of Crow Creek, 0.5 mile south of the Monarch veins at an elevation of 3,450 ft (fig. 29).

History and Production

The deposit was originally located in 1912 by a Mr. Whitney. It then changed ownership several times over the years. John Holmgren purchased the mine at an auction and owned it in 1931, according to Park (*37*). Development work in 1931 included 50 ft of drifting. Only minor production had occurred by 1933. The property was sold to Bruno Augustino Mining Co., owners of the Monarch Mine, in 1934. A new tram was constructed in 1937 to transport ore from the mine to the mill (*50*). The Jewel Mine's production, nearly all of which occurred from 1937 to 1942, is included in table 13 with that of the Monarch Mine.

Operating Data

Underground development consists of 285 ft of drift; 3 raises, one of which intercepts the surface 100 ft above the portal; and stoping. Ore was transported via tram to the mill; the tram cable is still present. A flotation circuit was installed at the Monarch mill to process ore from the Jewel Mine because of the high sulfide content.

Geologic Setting

The country rock near the Jewel Mine portal consists of well-bedded Valdez Group rocks that display a hornfels-like texture resulting from contact metamorphism by a nearby stock.

Park (*37*) accurately described the geology as follows:

> The country rock is banded argillite and graywacke with strike and dip the same as the vein, strike S30°E and dip 60°E. There are numerous intrusions of both medium and fine grained quartz diorite in the vicinity of this prospect, especially on the ridge east of it. The vein developed ranges in width from 2 inches to 1 foot and consists of quartz containing massive sulfides. Several other small veins are present on the property, but no work has been done on any of them.

Minerals identified in the Jewel vein include arsenopyrite, galena, chalcopyrite, pyrite, pyrrhotite, molybdenite, and gold. Limonite, cerussite, and scorodite occur as oxidation products. Two small veins striking north to N15°W and dipping 70°E are exposed just below the portal. These veins contain pyrite, arsenopyrite, galena, and very minor gold values.

Bureau Work

The lower Jewel adit was mapped and sampled in 1981. A bulk sample (7251) of the vein was collected and assayed by the Bureau in 1982. This sample contained 1.58 oz/st Au and 0.62 oz/st Ag. The presence of considerable arsenopyrite (up to 20 pct) might create milling difficulties. Fourteen additional samples (5558-5568, 7227-7228, and 7252) contained up to 4.74 oz/st Au and 2.1 oz/st Ag (appendix). The subsurface sample locations are shown on figure 32.

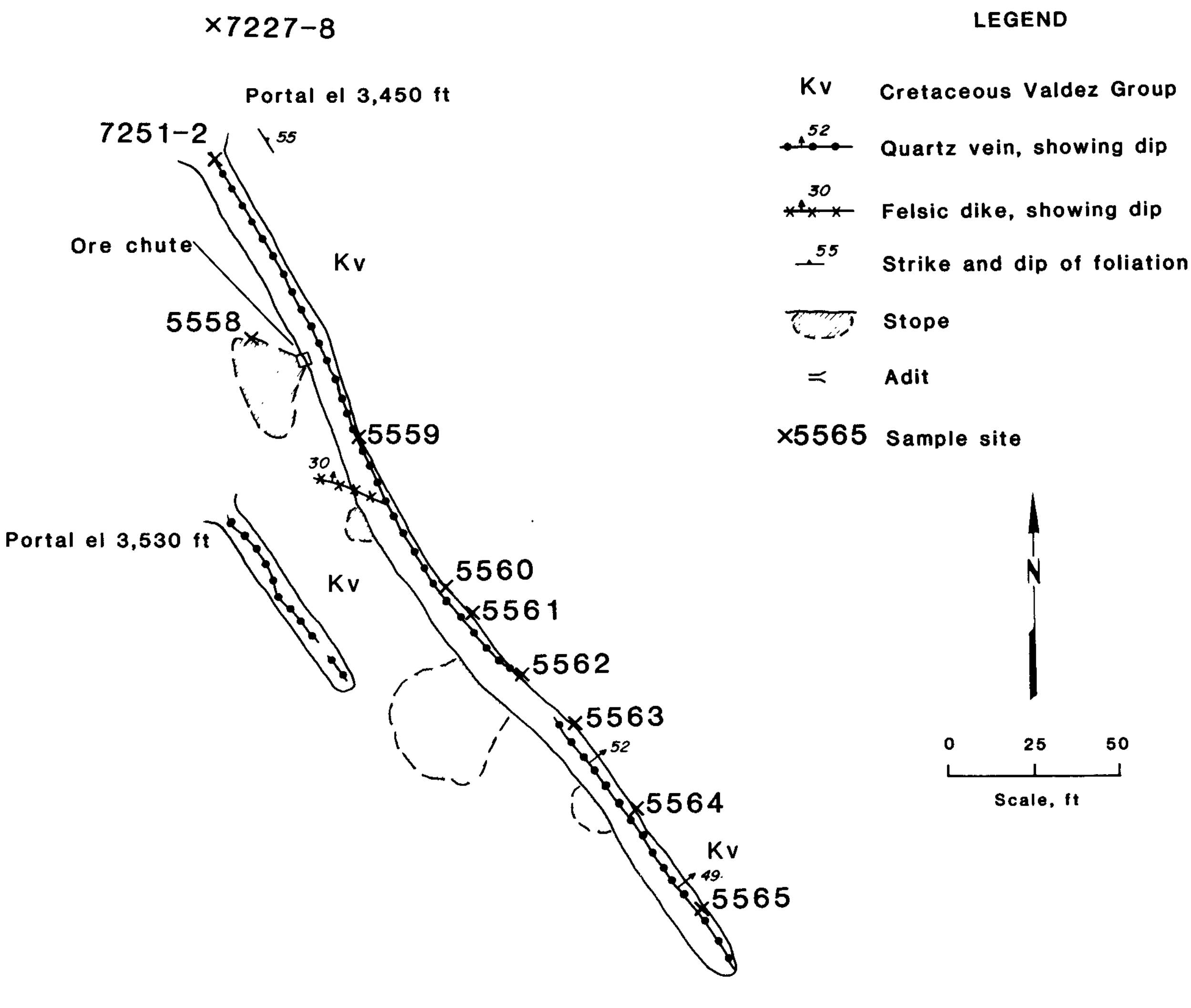


FIGURE 32.—Sample location map for Jewel Mine.

Resource Assessment

Bureau sampling identified an indicated resource of 3,100 st with a weighted-average grade of 1.75 oz/st Au and 0.75 oz/t Ag. This estimate was made using a strike length of 285 ft, a thickness of 0.5 ft, a combined depth of 263 ft (including 120 ft above the 3,450 ft-level), and a tonnage factor of 12. The deposit is open at depth. Based upon samples collected, additional exploration, including sampling and detailed geologic mapping, is warranted. The Jewel Mine has high mineral development potential.

SUMMARY AND RECOMMENDATIONS

The CNF contains numerous small lode gold deposits. These deposits are associated with Valdez Group flysch that has metamorphosed to a middle greenschist facies. Most of the past producers occur in clusters in the Valdez, Port Wells, Moose Pass, Summit Lake-Palmer Creek, and Girdwood areas. Of the total recorded lode gold production from deposits in and near the CNF (about 132,000 oz), over 58 pct (76,180 oz) came from two mines, the Cliff Mine near Valdez and the Granite Mine on Port Wells. Most of the remainder was produced from 14 additional deposits located in the 5 areas listed above. Available data indicate that 14 of the deposits discussed in this report contain an identified resource of 117,750 st with a weighted-average grade of 0.55 oz/st Au and 0.2 oz/st Ag.

History and available data suggest that future development of lode gold deposits will be largely restricted to small, locally high-grade gold-bearing quartz veins similar to those that have produced in the past. Bureau economic feasibility studies suggest that deposits similar in size and grade to those found at the Cliff and Granite Mines would be economically feasible to mine at gold prices in the range of $300 to $350 per ounce. Potential also exists for the development of large-tonnage, low-grade resources, such as those exemplified by the Gilpatrick and Palmer Creek dikes on the north-central Kenai Peninsula. Similar dikes occur in many other areas of the CNF but remain unevaluated at this time.

Further work is recommended to determine if several small deposits such as those clustered in the Moose Pass and Summit Lake-Palmer Creek areas could be feasibly developed simultaneously to contribute a combined tonnage to a small mill (50 to 100 st/d). Detailed geologic mapping should be completed, followed by surface trenching and sampling, and drilling, if warranted. In addition, a systematic sampling program is needed to further evaluate the mineral development potential of the Gilpatrick, Palmer Creek, and other mineralized dikes in the CNF. Additional work is warranted at most of the deposits discussed in this report. Specific recommendations are included in the resource assessment section for each deposit.

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APPENDIX.—QUANTITATIVE ANALYSES OF SAMPLES FROM SELECTED MINERAL DEPOSITS IN CHUGACH NATIONAL FOREST AREA

(Parts per million, as determined by atomic absorption, except that values listed with footnote number [3] are in ounces per short ton, as determined by fire assay, unless otherwise noted. Deposits are listed in order of discussion in this report.)

Sample Number[1]	Material[2]	Type[2]	Width, in	Au	Ag	Cu	Pb	Zn	As	Mo	Sb	Other information
						CLIFF MINE						
915	Metased, QV .	Grab ...	NAp	0.76	.81	10	ND	ND	ND	ND	ND	Quartz with argillite.
916	Pan conc	..do....	NAp	40	7.1	10	ND	ND	ND	ND	ND	Gravels from spit.
917	Metased	..do....	NAp	ND	ND	20	600	ND	ND	ND	ND	Slate, graywacke.
918	..do	..do....	NAp	ND	ND	ND	ND	ND	ND	ND	ND	Graywacke.
						RAMSAY-RUTHERFORD MINE						
1048 ...	Mill feed	..do....	NAp	02.35	02.1	60	ND	ND	ND	ND	ND	ND.
1077 ...	Mill conc.....	..do....	NAp	37.5	9.5	100	500	ND	ND	ND	ND	ND.
1836 ...	QV	..do....	NAp	[3].07	[3].1	14	76	440	15	2	ND	From dump.
			NAp	1.55	5.2	ND	ND	ND	ND	ND	ND	Do.
1928 ...	Mill conc.....	..do....	NAp	[3]26.1	[3]10.1	690	7,500	1,500	1,000	2	ND	Conc of mill conc.
						GOLD KING MINE						
1729 ...	QV	..do....	NAp	[3]04.85	[3]01.7	750	4,600	1,200	170	2	ND	Quartz from dump.
			NAp	180	60	ND	ND	ND	ND	ND	1,600	Do.
1730 ...	Metased	Random chip	72	.31	.3	30	36	84	65	2	ND	Slate wall rock.
1731 ...	..do	..do....	12	.09	.3	30	42	105	37	2	ND	Slate from shear.
1901 ...	QV	Chip	2	.32	.2	5	30	62	950	2	ND	Do.
1902 ...	Metased	Random chip.	24	.09	.1	11	21	105	80	2	ND	Quartz vein wall rock.
1903 ...	QV	Cont chip.	12	3.4	1.3	34	33	80	350	7	ND	Quartz vein from shear.
7932 ...	QV	Grab ...	NAp	[3]45.62	[3]1	11	4,300	1,500	ND	2	ND	Quartz vein with Au and galena.
						DONOHUE PROSPECT						
1785 ...	Metased, QV .	..do....	NAp	01.02	01.1	16	3	19	10	2	ND	Quartz from dump with pyrite.
1786 ...	..do	Chip	60	[3].003	[3].04	14	12	57	11	2	ND	Quartz stringer.
			60	.03	.4	ND	ND	ND	ND	ND	ND	Do.
1787 ...	..do	..do....	24	[3].003	[3].01	23	14	79	14	2	ND	Slate with quartz.
			24	.03	.2	ND	ND	ND	ND	ND	ND	Do.
1788 ...	..do	..do....	48	[3].003	[3].01	11	36	54	13	2	ND	Do.
			48	.03	.1	ND	ND	ND	ND	ND	ND	Do.
1844 ...	..do	..do....	14	[3].003	[3].01	14	14	26	10	2	ND	Quartz vein.
			18	.05	.7	ND	ND	ND	ND	ND	ND	Do.
1845 ...	..do	..do....	24	[3].413	[3].1	17	695	400	235	4	ND	Quartz, slate.
			24	8.18	6.6	ND	ND	ND	ND	ND	ND	Do.
1846 ...	QV	Grab ...	NAp	[3]100.2	[3]16.9	11	6,950	200	115	2	ND	High-grade vein.
500A ...	QV	..do....	NAp	.05	ND	5	5	20	ND	ND	ND	USGS sample.
500B ...	QV	..do....	NAp	2,500	300	15	2,200	95	ND	ND	ND	Do.
500C ..	QV	Chip ...	120	13	3	10	20	30	ND	ND	ND	Do.
500D ..	Metased	Grab ...	NAp	.2	.5	20	20	50	ND	ND	ND	USGS wall rock sample.
						GRANITE MINE						
4243 ...	..do	Chip	18	0.05	0.2	ND	ND	ND	30	ND	ND	Snowball 720-ft level.
4244 ...	QV	Grab ..	NAp	14	2.8	15	445	435	40	ND	ND	350-ft level dump.
4245 ...	QV	..do..	NAp	12	4	80	235	400	300	ND	ND	200-ft level stamp mill.
4246 ...	QV	..do ...	NAp	4.2	2.8	25	135	65	160	ND	ND	200-ft level ore bin.
4247 ...	QV	..do ...	NAp	1.3	.4	ND	ND	ND	ND	ND	ND	200-ft level dump.
4248 ...	QV	..do ...	NAp	.08	.2	ND	ND	ND	ND	ND	ND	Do.
4249 ...	Fel plut	..do ...	NAp	.06	.2	ND	ND	ND	ND	ND	ND	200-ft level.
5740A ..	QV	Chip ...	18	71	26	2	230	135	22	ND	ND	35-ft level face.
5470B .	..do	Spec ...	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	ND.
6280 .	..do	Grab ...	NAp	.05	<.2	5	5	15	ND	ND	ND	ND.
6281 ...	..do	Spec ...	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	ND.
6282 ...	Metased, QV	Grab ..	NAp	.53	.2	20	15	65	ND	ND	ND	ND.
7001 ...	Fel plut .	..do.	NAp	.44	.2	<5	10	35	500	ND	ND	350-ft level.
7002 .	QV	..do	NAp	2.4	2.6	15	30	5	<500	ND	ND	Do.
7003 .	Metased	..do ..	NAp	.15	.4	100	15	125	<500	ND	ND	Do.
7004 .	QV	..do ...	NAp	2.4	1.8	75	25	120	500	ND	ND	Do.
7005 ..	QV	do .	NAp	1.5	2	110	90	30	<500	ND	ND	Do.
7006 ..	Metased .	do	NAp	.19	.4	45	15	115	500	ND	ND	Do.
7007 ..	QV	..do .	NAp	3.3	5.6	75	20	140	7,000	ND	ND	Do.
7008 .	Metased	..do .	NAp	.02	.2	40	10	100	<500	ND	ND	Do.
7009 ...	QV	..do....	NAp	3.9	2.8	80	40	145	1,500	ND	ND	Do.
7232 ..	Mill tailings . .	Bulk	NAp	[3].194	ND	ND	ND	ND	ND	ND	ND	Bulk for cyanide leaching.
7233 ...	Beach material	Placer ..	NAp	NAp	ND	ND	ND	ND	ND	ND	ND	Several fine colors Au recovered.
						MINERAL KING MINE						
5417 ...	Alluvium	do.	NAp	ND	ND	ND	ND	ND	ND	ND	ND	0.001 oz/yd³ Au recovered.
5418 ..	Mill feed ..	Grab	NAp	5.3	4.3	110	165	150	100	ND	ND	Collected from stamp mill.
5419 ...	Alluvium ...	Placer ..	NAp	ND	ND	ND	ND	ND	ND	ND	ND	0.018 oz/yd³ Au recovered.
5443	Qv fault gouge	Grab ...	NAp	<.03	.76	5	9	ND	21	ND	ND	Main adit metased host.
5444 ...	QV	Chip ...	4	.05	1.2	600	160	67	ND	ND	ND	Do.
5445 ..	QV	.do....	6	.35	3.8	18	140	30	30	4	22	Main adit granite host.
5446 ...	QV	..do....	3	.54	3.4	ND	ND	20	410	ND	ND	Do.
5447	Granite .	Grab ...	NAp	<.03	.49	ND	ND	ND	ND	ND	ND	Main adit.
5448	QV	Chip ...	4	.82	.95	ND	ND	ND	3,200	ND	ND	Metased host.
5449	QV .. .	do.	6	ND	ND	ND	ND	ND	ND	ND	ND	ND.
5450	QV ...	Spec	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	Granite host.
6313 .	Mill feed ..	Grab .	NAp	3.2	2	70	120	140	10	ND	ND	Collected from stamp mill.

See explanatory notes at end of table.

Sample			Width, in	Au	Ag	Cu	Pb	Zn	As	Mo	Sb	Other information
Number[1]	Material[2]	Type[2]										
						CULROSS MINE						
3337	QV	Grab	NAp	[3]<0.005	<0.2	18	9	11	380	ND	2	Quartz float, 1 pct arsenopyrite.
3339	Metased	Random chip.	NAp	<.005	<.2	65	23	75	39	ND	6	Mudstone.
3340	Metased, QV	Random chip.	NAp	<.005	<.2	105	33	67	170	ND	2	10- by 15-ft iron-stained shale. Quartz veinlets, up to 5 pct pyrite.
3342	QV	..do....	48	<.005	<.2	4	7	13	10	ND	4	Av 4-ft-wide quartz vein exposed for 50 ft.
3344	Maf volc	..do....	NAp	<.005	<.2	57	14	26	10	ND	3	Greenstone.
3470	QV	Grab	NAp	.16	<.2	85	1,000	15	1,000	ND	2	Vein quartz float in open cut.
3502	Maf volc	Cont chip.	24	.005	<.2	62	36	46	790	ND	6	Quartz-chlorite semi-schist.
3503	..do	..do....	84	.026	<.2	77	28	32	19	ND	4	Shear zone; quartz stringer.
3504	..do	..do....	12	.047	<.2	6	14	14	21	ND	1	Greenstone semischist with quartz-chlorite veins.
3505	QV	..do....	24	.052	<.2	52	140	30	1,300	ND	2	Sheared greenstone with quartz calcite veins 1 in to 1 ft wide.
3506	Maf volv	..do....	30	.02	.6	78	485	26	4,100	ND	3	Sheared greenstone with quartz calcite veins.
3509	QV	..do....	18	.008	<.2	800	7,600	2,900	88	ND	7	4-ft-wide shear zone; quartz-calcite veins.
3649	Str Sed	Grab	NAp	.06	.4	30	31	69	18	ND	<1	Stream silt below mine workings.
3650	Maf volc	Random chip.	NAp	<.005	<.2	78	13	13	<10	ND	1	Cherty greenstone.
3653	Maf volc	Cont chip.	60	<.005	.2	69	29	31	193	ND	2	Shear zone with numerous quartz veinlets.
3654	QV	Random chip.	NAp	<.005	.2	11	20	11	129	ND	<1	Quartz veinlets, <1 in to 5 ft wide.
3655	Maf volc	..do....	NAp	<.005	.2	40	33	26	200	ND	69	Sheared pillow basalt with calcite stringers.
3656	QV	..do....	18	.02	.2	66	42	10	440	ND	ND	Calcite-quartz vein 1.5 ft wide.
3658	QV	Chip....	12	<.005	.2	255	345	350	1,100	ND	2	1-ft-wide quartz vein with minor sulfide and calcite.
3659	QV	Select grab.	NAp	Trace	.2	45	29	20	104	ND	ND	Quartz float with dark gray bands.
3662	Maf volc	Random chip.	NAp	<.005	.2	72	18	22	<1	ND	1	Schistose greenstone with quartz stringers and lenses.
3663	..do	..do....	NAp	<.005	.2	105	18	16	22	ND	<1	Sheared greenstone with quartz stringers and blebs.
4254	QV	Grab	NAp	.82	.2	5,800	ND	ND	ND	ND	ND	Quartz vein float on adit floor. Visible galena.
4255	QV	Select grab.	NAp	3.1	4.2	ND	ND	ND	3,300	ND	ND	Quartz vein float on adit floor; contains pyrrhotite and malachite.
4256	QV	Random chip.	NAp	13	7	ND	ND	ND	3,000	ND	ND	Quartz with visible galena.
4257	QV	..do....	NAp	9.5	1.4	ND	ND	ND	3,600	ND	ND	Quartz vein with sulfides.
4258	Maf volc	Grab	NAp	12	11	1,000	8,700	5,300	ND	ND	ND	Dump sample.
4263	QV	Select grab.	NAp	300	65	550	3,600	7,000	1,500	ND	ND	Crushed quartz remaining in mill.
5186	QV	..do....	NAp	30	10.1	480	685	170	2,300	ND	ND	Do.
5390	Maf volc	Grab	NAp	5.2	3.6	245	400	ND	355	2	ND	Fine debris in bottom of stope.
5391	QV	Chip....	6	22	11	495	4,100	ND	4,900	ND	ND	Quartz vein.
5393	Maf volc	Random chip.	NAp	.05	3	110	24	58	44	ND	ND	Greenstone, minor pyrrhotite.
						PORTAGE BAY MINE						
4991	QV	Chip.	6	ND	ND	ND	ND	ND	ND	ND	ND	1,550-ft level.
4992	QV	..do....	8	0.3	1.6	30	490	590	250	ND	ND	Do.
4993	Metased	..do....	18	[3].01	[3]<.02	50	21	100	38	2	ND	Do.
4994	QV	..do....	18	.45	2.4	89	33	74	110	ND	ND	Do.
4995	Metased	..do....	12	.35	.85	34	26	91	100	ND	ND	Do.
4996	Alluvium	Pan conc	NAp	11.31	6	27	25	100	ND	ND	ND	10 colors.
5458	QV	Grab	NAp	[3].015	[3].02	40	11	50	125	3	6	1,500-ft level stope.
5459	QV	Chip....	24	[3].013	[3].02	50	20	50	30	ND	ND	1,500-ft level raise.
5460	QV	..do....	14	16.6	5.6	40	190	50	120	ND	ND	Do.
5461	Fel plut	Grab	NAp	.2	1.1	7	22	53	130	ND	ND	Do.
5692A	..do	Chip....	18	<.03	.1	5	22	37	27	ND	ND	1,700-ft level.
5692B	QV	Channel.	4	2.5	1.3	58	34	135	89	ND	ND	Do.
5692C	QV	Chip....	8	[3].294	[3]<.2	10	78	180	580	3	ND	Do.
5692D	QV	..do....	4	.03	.8	16	105	78	100	ND	ND	Visible Au in sample.
5692E	Ore dump	Pan conc	NAp	ND	ND	ND	ND	ND	ND	ND	ND	1,700-ft level. Visible Au in sample.
						PRIMROSE MINE						
7174	QV	Cont chip.	10	[3]01.572	[3]0.6	150	970	365	9,200	4	7	Upper-level portal.
7175A	QV	Channel.	6	[3]1.166	[3].6	260	620	213	3,500	4	4	Do.
7175B	QV	Spec	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	Do.
						CROWN POINT MINE						
5288	QV	Chip....	18	08.6	04.1	40	37	110	880	ND	ND	4,500-ft level.
5289	Metased, QV	..do....	20	30	8.1	38	54	115	690	ND	ND	Do.
5290	QV	Grab	NAp	[3]1	11.5	24	103	53	340	ND	ND	4,450-ft level.
5291	QV	Chip....	12	13	4.4	44	47	145	1,850	ND	ND	4,320-ft level.

See explanatory notes at end of table.

Sample				Au	Ag	Cu	Pb	Zn	As	Mo	Sb	Other information
Number[1]	Material[2]	Type[2]	Width, in									
						CROWN POINT MINE—Continued						
5292	QV	Chip	10	19	5.4	28	41	25	690	ND	ND	4,320-ft level.
5293	QV	do	6	97	19.5	23	156	58	600	ND	ND	Do.
5294	QV	do	26	34	9.5	37	152	69	900	ND	7	Do.
5295	QV	Grab	NAp	5.1	1.6	32	56	43	450	ND	ND	4,170-ft level.
5302	QV	do	NAp	55	14.5	63	217	120	480	ND	ND	Hanging wall, side vein, 4,320-ft level.
5303	QV	Grab	NAp	39	9.5	29	103	32	775	ND	ND	Footwall, side vein 4,320-ft level.
5304	QV	do	NAp	39	7.2	27	56	26	740	ND	ND	4,450-ft level.
5307	QV	do	NAp	.08	1	29	6	24	615	ND	5	Not on main system vein.
5308	QV	do	NAp	14	4.5	ND	ND	ND	170	ND	ND	West of upper portal.
5309	QV	Chip	6	.08	1.4	ND	ND	ND	10	ND	ND	Do.
5684	QV	Channel	8	[3]2.2	[3].51	ND	ND	ND	ND	ND	ND	4,320-ft level, 300-lb bulk sample.
7141	Metased, QV	Grab	NAp	[4].0058	ND	ND	ND	ND	ND	ND	ND	Debris from floor to be panned.
						SKEEN-LECHNER MINE						
4824	QV	Chip	54	0.38	2	40	10	30	2,000	ND	ND	Upper vein, 3,210-ft level.
4825	QV	do	24	17	5.9	38	90	40	ND	ND	ND	Do.
4826	QV	do	36	<.03	1.7	40	5	40	ND	ND	ND	Do.
4827	QV	do	18	.85	2.8	35	15	50	ND	ND	ND	Do.
4828	HW Metased	do	18	<.03	2.1	36	14	60	ND	ND	ND	Do.
4829	QV	do	48	.1	1.9	40	14	80	ND	ND	ND	Do.
4830	QV	do	48	.1	1.9	32	55	80	ND	ND	ND	Do.
4831	Metased	do	18	.1	3.4	35	36	250	ND	ND	ND	Do.
4832	QV	Grab	NAp	35	16	43	650	150	ND	ND	ND	Do.
4833	Mill feed	do	NAp	31	9.3	37	135	100	10,000	ND	ND	Mill site.
4834	QV	do	NAp	12.5	5.2	35	70	150	ND	ND	ND	Upper vein dump, 3,260-ft level.
4835	QV	Chip	24	360	30	38	450	80	ND	ND	ND	Upper vein, 3,260-ft level.
4836	QV	Select chip.	2	29	9.7	30	160	210	ND	ND	ND	Do.
4837	QV	Chip	36	.27	1	30	10	55	ND	ND	ND	Upper vein, 3,210-ft level.
7132	QV	do	14	[3]3.322	[3].6	8	300	105	870	3	3	Upper vein, 3,260-ft level.
7133	QV	do	15	[3].054	[3].2	<1	76	43	380	2	3	Do.
7134	QV	Grab	NAp	[5].0029	ND	ND	ND	ND	ND	ND	ND	Panned 3,260-ft level.
7135	QV	Chip	3	[3].554	[3].4	<1	24	13	260	ND	ND	ND.
7136	QV	do	6	[3]<.005	[3].3	4	<1	26	15	ND	ND	ND.
7137	Quartz debris	Grab	NAp	[6].0012	ND	ND	ND	ND	ND	ND	ND	Panned upper vein, 3,210-ft level.
7138	QV	do	NAp	[3]<.005	[3].2	4	8	84	610	ND	ND	Upper vein, 3,210-ft level.
7140	QV	Spec	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	Upper level, 3,260-ft level.
						FALLS CREEK MINE						
4823	QV	Chip	72	03.25	02.4	50	46	50	ND	ND	ND	ND.
						EAST PONT MINE						
4838	QV	Grab	NAp	200	03.5	30	350	70	10,000	ND	ND	Assorted quartz from mill.
7139	QV	Chip	4	[3]2.204	[3].8	3	78	37	3,800	4	7	Vein exposed 50 ft north of portal.
1054	QV	Grab	NAp	[3].16	[3].36	ND	ND	ND	ND	ND	ND	O'Neill (*36*) sample.
1055	QV	Chip	12	[3].01	[3]1.35	ND	ND	ND	ND	ND	ND	Do.
1056	QV	do	8	[3]5.85	[3]2.07	ND	ND	ND	ND	ND	ND	Do.
						GILPATRICK MINE						
4429	Fel plut, QV	Grab	NAp	03.2	0.6	5	245	100	ND	<2	ND	3,300-ft level dump.
4719	QV	do	NAp	2	.2	ND	ND	ND	ND	<2	ND	ND.
4720	Fel plut, QV	do	NAp	54	13	ND	ND	ND	ND	<2	ND	ND.
4783	QV	do	NAp	10	7.5	40	1,650	660	700	ND	ND	ND.
5361	QV	do	NAp	11	3	150	290	340	ND	ND	ND	ND.
5646	QV	do	NAp	ND	ND	ND	ND	ND	ND	ND	ND	Not assayed.
5647	QV	do	NAp	[3]8.51	[3]3.2	19	4,000	400	890	<2	ND	3,400-ft level dump.
5648	Fel plut, QV	Cont chip.	14	.88	.73	2	45	46	178	2	ND	Do.
5649	QV	do.	10	[3].89	[3].65	9	520	145	180	2	ND	3,400-ft level portal.
7191	Elluvium	Bulk placer	NAp	ND	ND	ND	ND	ND	ND	ND	ND	0.0032 oz/yd³ Au recovered by sluicing 0.1 yd³ of elluvium.
						SUMMIT VEIN PROSPECT						
4781	QV	Grab	NAp	[3]02.82	[3]01.7	46	8,000	340	1,250	ND	ND	NW end of vein.
4782	QV	do	NAp	8.4	.46	91	1,700	450	38	ND	ND	SE end of vein.
4784	QV	do	NAp	[3]5.15	[3]3.5	22	5,000	310	55	ND	ND	NW end of vein.
4785	QV	Cont chip.	18	[3]1.18	[3]1.4	140	15,000	830	410	ND	ND	Do.
4786	Metased	do	8	.1	.85	27	730	930	4,350	ND	ND	NW end; hanging wall.
4787	do	do	8	.13	4	91	50	2,400	440	ND	ND	NW end, footwall.
5650	QV	Spec	18	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NW end. Not assayed. Contained visible Au.
5651	QV	Channel	18	[3]1.35	[3].84	ND	ND	ND	ND	ND	ND	NW end; bulk sample.
5652	QV	do.	18	ND	ND	ND	ND	ND	ND	ND	ND	NW end; crushed and panned. Not assayed. Panned considerable free Au.
5683	QV	Spec	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	SE end. Not assayed. Contained visible Au.
						HEASTON-ORACLE MINE						
4774	QV	Cont chip.	8	[3]01.64	[3]0 71	98	1050	66	2,500	ND	ND	1,900-ft portal.
4775	Metased	Chip	8	.1	.44	ND	ND	ND	300	ND	ND	Hanging wall, 1,900-ft portal.
4776	Metased	Chip	10	1.55	3	ND	ND	ND	3,650	ND	ND	Footwall, 1,900-ft portal.
4777	QV	Grab	NAp	.55	.57	3	10	39	15,600	ND	ND	2,100-ft adit north side creek.

See explanatory notes at end of table.

Sample Number[1]	Material[2]	Type[2]	Width, in	Au	Ag	Cu	Pb	Zn	As	Mo	Sb	Other information
				HEASTON-ORACLE MINE—Continued								
4778	QV	Grab	NAp	1.4	1.5	44	140	83	2,550	ND	ND	2,000-ft adit north side creek.
5665	QV	Mineral spec.	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	1,900-ft portal. Visible Au.
				HIRSHEY-LUCKY STRIKE MINE								
5639	QV	Cont chip.	3	0.47	0.75	6	15	19	36	<2	<1	3,200-ft level.
5640	QV	Random chip.	8	99.6	65	ND	ND	ND	ND	ND	ND	3,400-ft level.
5641	QV	do	8	[3].175	[3]<.1	49	415	165	300	ND	ND	Do.
5642	QV	Cont chip.	24	[3]1.21	[3].09	21	1,550	1,400	6,500	<2	3	Do.
5643	QV	do	3	[3].364	[3]<.01	33	660	130	310	ND	ND	Do.
				NEARHOUSE MINE								
4436	QV	Random grab.	NAp	7.3	12	10	330	85	ND	ND	ND	Dump, 3,100-ft level.
4755	QV	do	18	.15	4.5	ND	ND	ND	2,600	ND	ND	Face, 3,050-ft level.
4756	Metased	do	18	<.03	4	ND	ND	ND	190	ND	ND	Face, 3,050-ft level, footwall.
4757	Metased	Chip	6	.05	.89	ND	ND	ND	160	ND	ND	Face, 3,050-ft level, hanging wall.
4758	QV	QV	NAp	<.03	.49	ND	ND	ND	37	ND	ND	West drift, 3,100-ft level.
4759	QV	Random chip.	6	.75	1	ND	ND	ND	ND	ND	ND	Do.
4760	QV	do	14	3.15	3.3	ND	ND	ND	2,050	ND	ND	Do.
4761	QV	Cont chip.	36	15.3	.79	10	810	450	345	ND	ND	East drift, 3,100-ft level.
4762	QV	Grab	NAp	3.05	5	ND	ND	ND	150	ND	ND	Do.
4763	Felsic dike	do	NAp	1.45	3.4	10	135	92	480	ND	ND	Do.
4764	Metased	do	NAp	.08	.92	ND	ND	ND	89	ND	ND	East drift, 3,100-ft footwall.
4765	do	do	NAp	.05	2	ND	ND	ND	125	ND	ND	East drift, 3,100-ft hanging wall.
4766	Felsic dike	do	NAp	<.03	.16	ND	ND	ND	10	ND	ND	Surface, 3,950 ft.
4767	do	do	NAp	.04	.5	42	7	51	115	ND	ND	Do.
4768	do	do	NAp	.03	.19	ND	ND	ND	19	ND	ND	Do.
4769	QV	do	NAp	.25	.44	8	14.5	300	425	ND	ND	Surface, 4,000 ft.
5610	QV	Spec	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	ND.
5801	QV	Cont chip.	16	[3].136	[3].5	18	870	300	ND	<2	ND	Winze at 31 ft from top.
5802	QV	do	10	.07	.2	10	260	135	ND	3	ND	Winze at 81 ft from top.
5803	Metased	do	24	.23	1.8	43	24	145	ND	2	ND	Winze at 81 ft from top, hanging wall.
5804	do	do	24	ND	ND	ND	ND	ND	ND	ND	ND	Winze at 81 ft from top, footwall. No data received.
5805	QV	Cont chip.	18	.385	.5	71	34	180	250	2	ND	Winze at 46 ft from top.
5806	QV	do	8	11.4	5.1	22	345	270	1,900	2	ND	West drift.
5807	QV	do	3	6.4	5.1	18	410	115	440	2	ND	Do.
				GILPATRICK DIKE: GILPATRICK PROSPECT								
4413	Fel plut, QV	Random chip.	48	0.04	0.6	30	20	<200	500	<2	ND	Near portal.
4788	QV	Grab	NAp	14.5	830	1,060	1,150	470	550	ND	ND	Dump.
5682A	Fel plut, QV	Cont chip.	14	.54	3.5	19	37	39	450	<2	1	Adit 34 ft from portal.
5682B	do	do	36	.66	7.4	18	32	24	285	<2	2	Adit 10 ft from portal.
				GILPATRICK DIKE: SHELL PROSPECT								
4404	QV	Grab	NAp	03.9	02.4	5	235	195	200	ND	ND	Adit dump.
4405	QV	do	NAp	<.02	<.2	10	20	25	ND	ND	ND	ND.
4406	Fel plut	do	NAp	.04	<.2	ND	ND	ND	ND	ND	ND	ND.
5661	QV	do	NAp	ND	ND	ND	ND	ND	ND	ND	ND	Shaft dump.
5662	QV	do	NAp	[3].396	[3].3	7	375	115	2,700	ND	ND	Do.
5663	QV	do	NAp	7.1	5.1	13	295	210	660	ND	ND	Do.
5664	QV	do	NAp	10.7	13	7	760	150	230	ND	ND	Prospect pit.
				GILPATRICK DIKE: COLORADO PROSPECT								
4398	Fel plut	Grab	NAp	ND	ND	ND	ND	ND	ND	ND	ND	2,800-ft prospect pit.
4399	Fel plut, QV	do	NAp	0.08	5.2	10	1,200	335	2,700	ND	ND	2,600-ft prospect pit.
4400	QV	Grab	NAp	<.02	.2	ND	ND	ND	10	ND	ND	2,800-ft caved adit.
4401	Fel plut, QV	do	NAp	<.02	.2	ND	ND	ND	10	ND	ND	2,700-ft prospect pit.
4407	do	Chip	48	<.02	.2	20	15	20	ND	ND	ND	2,400-ft adit.
				PALMER CREEK DIKE: TEDDY BEAR PROSPECT								
4431	Fel plut, QV	Chip	36	0.14	0.2	5	35	40	500	ND	ND	ND.
7156	Fel plut	Select grab.	NAp	[3].117	.2	8	71	51	635	ND	ND	ND.
				PALMER CREEK DIKE: KENAI STAR PROSPECT								
4433	Fel plut, QV	Random chip.	36	05.1	02.2	5	655	30	ND	ND	ND	Surface.
4434	Str sed	Pan	NAp	<.04	.2	50	20	110	ND	ND	ND	No Au recovered.
4435	Fel plut, QV	Random chip.	NAp	<.05	.2	15	10	30	ND	ND	ND	Upper adit.
4451	Str sed	Pan	NAp	ND	ND	ND	ND	ND	ND	ND	ND	3 very fine colors Au recovered.
				MONARCH MINE								
5473	Metased	Grab	NAp	<0.03	01.4	100	19	ND	17	6	ND	South vein.
5474	QV	Chip	5	3.55	3	25	7	ND	1,000	<2	ND	Do.
5475	QV	do	4	2	1.8	41	110	ND	2,500	3	ND	Do.

See explanatory notes at end of table.

Sample Number[1]	Material[2]	Type[2]	Width, in	Au	Ag	Cu	Pb	Zn	As	Mo	Sb	Other information
						MONARCH MINE—Continued						
5476	QV	do	4	19.5	92	45	27	ND	2,600	<2	ND	South vein.
5477	Metased	Grab	NAp	<.03	2.1	85	18	ND	34	ND	ND	Do.
5478	do	do	NAp	.15	1.6	375	22	ND	34	ND	ND	Do.
5479	do	do	NAp	<.03	.44	770	18	ND	23	ND	ND	Do.
5480	QV	Chip	18	2.5	2.4	56	16	ND	2,000	3	ND	North vein.
5481	QV	do	24	1.5	4.6	145	38	ND	2,000	<2	ND	Do.
5552	QV	do	8	[3]2.53	[3].94	32	230	56	13,400	2	ND	N45°W vein, 3,500 ft.
5553	QV	do	10	.19	.4	170	2	27	159	<2	ND	Do.
5554	Metased	do	4	.03	2.6	2,000	1	56	67	6	ND	Hanging wall.
5555	do	do	12	.08	1.2	500	4	74	275	3	ND	Footwall.
5556	QV	do	15	.25	1.6	160	13	41	480	39	ND	Footwall, N15°W vein.
5557	QV	Grab	NAp	.04	1.8	145	1	14	45	400	ND	Do.
5611	QV	Chip	5	20	5	20	550	400	1,500	ND	ND	South vein.
5612	Metased	do	5	<.02	<.5	25	10	120	ND	ND	ND	Do.
5613	do	do	5	<.02	<.5	15	15	150	ND	ND	ND	Do.
5614	do	do	9	<.02	<.5	20	20	140	ND	ND	ND	Do.
5615	do	do	6	<.02	<.5	15	10	140	500	ND	ND	Do.
5616	do	do	6	.05	.11	21	24	84	420	<2	2	Do.
5617	do	do	6	.06	.07	270	12	59	450	<2	3	Do.
5618	QV	do	3	1.2	1.2	2	5	11	520	<2	2	Do.
5619	QV	do	2	1.5	4.6	200	11	13	4,550	8	2	Do.
5620	Metased	do	6	.08	.44	255	13	65	250	<2	3	Do.
				.13	2.4							
5621	do	do	6	.46	4.6	410	13	36	127	<2	1	Do.
5622	QV	do	5	.75	.88	25	<7	33	2,360	ND	ND	Do.
5623	QV	do	24	[3]1.17	[3].84	77	12	91	3,900	ND	ND	Do.
5624	Metased	Grab	NAp	.07	<.03	48	15	63	32	ND	ND	Do.
5625	QV	do	NAp	.35	.34	43	9	1	1,080	ND	ND	Do.
5626	QV	Chip	2	<.02	1.2	410	9	44	11	ND	ND	N-S vein.
5627	QV	do	2	9.32	3.1	38	11	32	183	ND	ND	South vein.
5629	QV	do	5	<.02	1.4	390	10	2	156	31	ND	N-S vein.
5630	QV	do	4	<.03	.64	125	5	1	34	12	ND	Do.
5631	QV	Grab	NAp	<.03	.7	320	14	18	41	44	ND	Do.
5632	QV	Channel	12	1.06	.45	5	5	1	4,000	<2	ND	North vein.
5633	Metased, QV	do	14	.01	1.2	82	17	63	6,450	<2	ND	Do.
5634	Metased	Chip	12	.37	135	33	13	65	390	ND	ND	Do.
5635	do	do	24	.12	1.93	19	12	89	175	ND	ND	Do.
5636	QV	do	12	234	92	54	37	21	4,790	<2	ND	Do.
5637	Metased	do	12	.24	4.6	495	12	31	2,600	34	ND	Do.
5638	do	do	12	.33	3.68	385	12	73	2,550	ND	ND	Do.
5755	Metased, QV	Channel	60	.07	3.9	275	8	56	1,290	<2	ND	Do.
						JEWEL MINE						
5558	QV	Chip	6	[3]0.463	[3]0.3	180	1,770	1,070	10,100	<2	ND	3,450-ft level.
5559	QV	do	6	[3]4.74	[3]2.1	135	1,000	1,520	1,740	ND	ND	Do.
5560	QV	do	10	[3]1.08	[3].4	67	465	205	13,200	ND	ND	Do.
5561	QV	do	6	1.9	1.8	4	37	22	14,850	ND	ND	Do.
5562	QV	do	4	[3]2.5	[3]1	29	980	805	13,750	<5	ND	Do.
5563	QV	do	5	[3]1.66	[3].95	93	5,070	6,250	47,300	10	ND	Do.
5564	QV	do	4	[3].764	[3].47	18	2,920	970	203,000	<2	80	Do.
5565	QV	Chip	4	[3]1.35	[3].59	35	650	1,150	11,850	ND	ND	Do.
5566	Metased	Grab	NAp	.08	.4	76	14	140	180	ND	ND	Surface sample.
5567	QV	Chip	3	[3].455	[3].22	20	510	760	14,300	<2	ND	Do.
5568	QV	do	15	[3]1.27	[3].41	23	2,700	1,540	30,900	<2	ND	Do.
7227	QV	Grab	NAp	Trace	ND	<10	<200	250	1,100	<5	80	N-S vein.
7228	QV	Chip	3	ND	ND	<10	980	260	5,300	<5	80	Do.
7251	QV	Grab	NAp	[3]1.58	[3].62	300	ND	ND	ND	ND	ND	Bulk sample.
7252	QV	Spec	NAp	ND	ND	ND	ND	ND	ND	ND	ND	Portal, 3,450-ft level.

NAp Not applicable. ND Not determined.
[1]Sample numbers referred to in text, illustrations, and other Bureau reports.
[2]Explanation of abbreviations used:

Cont chip	Continuous chip	Pan conc	Pan concentrate
Fel plut	Felsic pluton	QV	Quartz vein
Maf volc	Mafic volcanics	Spec	Specimen
Metased	Metasedimentary rock including slate and quartzite	Str sed	Stream sediment

[3]Ounces per short ton
[4]Amount recovered from approximately 50 lb of debris collected from floor of 4,320-ft level by panning and amalgamating the concentrate
[5]Amount recovered from panning approximately 7 lb of debris collected on 3,260-ft level.
[6]Amount recovered from amalgamating pan concentrate from 7 lb of debris collected in stope.

INT.-BU.OF MINES,PGH.,PA. 28428

U.S. GOVERNMENT PRINTING OFFICE: 1986 - 605-017/40109