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Gold-Lode Deposits, Fairbanks Mining District, Central Alaska



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Gold-Lode Deposits, Fairbanks Mining District, Central Alaska

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GOLD-LODE DEPOSITS, FAIRBANKS MINING DISTRICT, CENTRAL ALASKA

by

Bruce I. Thomas¹

ABSTRACT

The Fairbanks mining district forms an arc 40 miles long and 8 miles wide on the north side of the Tanana Valley in central Alaska. This is a region of broad valleys and rounded hills that range in elevation from 600 to 2,600 feet. Lode-gold production started in 1910 and has continued sporadically to the present, but the largest single mine produced only 40 tons per 24-hour day. Total recorded lode-gold production of the district is 241,000 fine troy ounces of gold from ore that averaged 1.32 fine ounces per ton. The ore was mined chiefly from narrow veins and veinlets alined along anticlinal folds at Ester Dome and the Pedro Dome-Cleary area. The only proven reserves are reported to be at the Ryan Lode at Ester Dome and at the Keystone Mines, Inc., holdings in the Pedro Dome-Cleary area. An inferred lode-gold resource for the district of approximately 4,000,000 ounces is considered to indicate only the order of magnitude of the lode-gold potential because of the absence of detailed data needed to evaluate the numerous deposits.

INTRODUCTION

Lode-gold mining in the Fairbanks mining district in central Alaska is at a standstill; sporadic attempts to resume hardrock mining soon wane. However, improvements in rock fragmentation, materials handling, and beneficiation techniques appear to justify a renewed investigation. Modern mining and milling equipment used in accordance with a well-planned system would improve ore extraction and metal recovery. Grouping properties in the Pedro Dome-Cleary area so that several mines could be worked from a common entry to feed an efficient, centrally located mill might make it practical to resume underground mining in this vicinity. The open pit potential of the Ester Dome area also deserves investigation.

This Bureau of Mines report describes the lode-gold mines of the Fairbanks mining district and presents historical and production data derived from many sources as a basis for additional investigations.

¹Mining engineer.

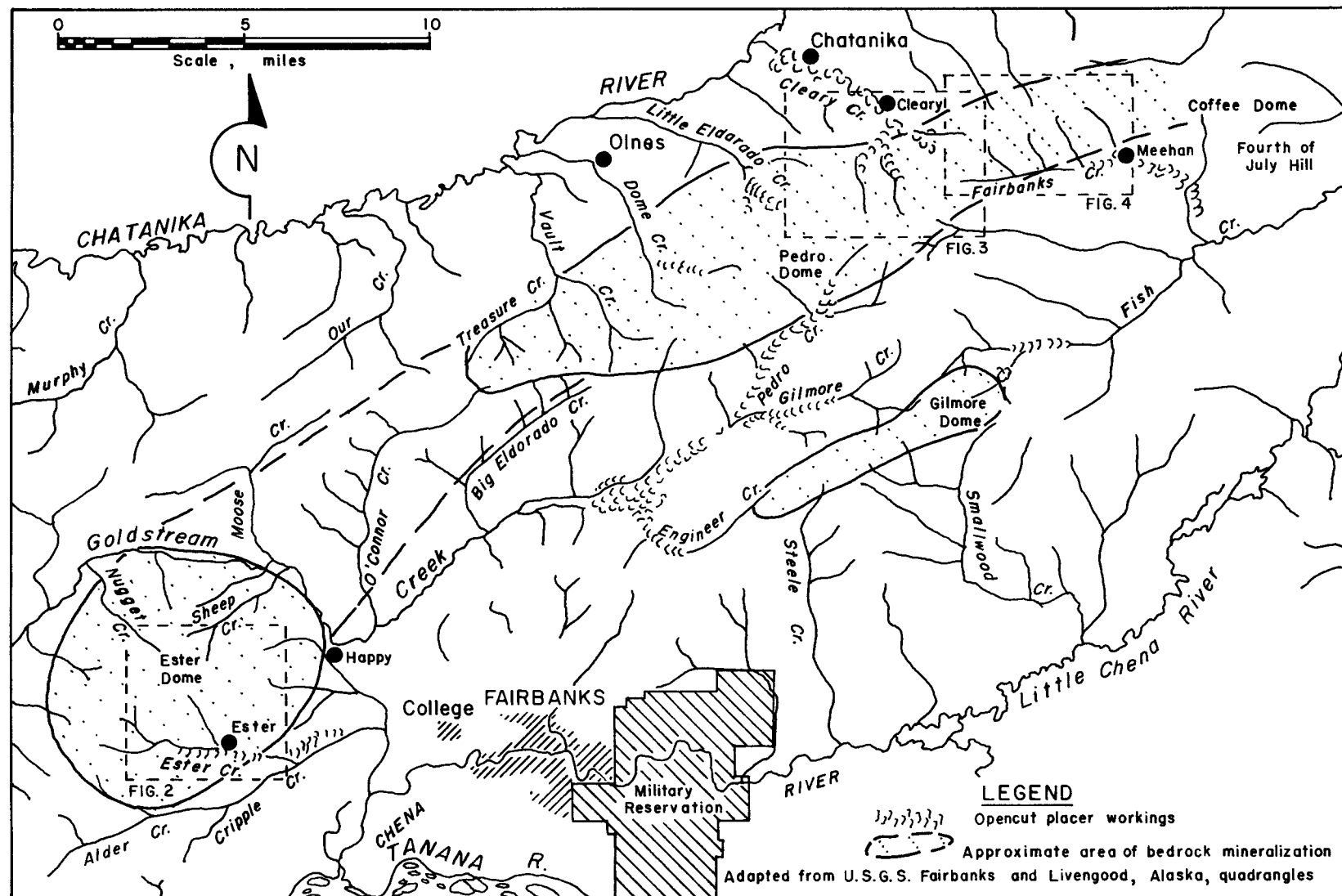


FIGURE 1. - Principal gold-lode mining areas, Fairbanks district, Alaska;

LOCATION AND ACCESSIBILITY

The core of the Fairbanks mining district (fig. 1) is an arcuate belt, about 40 miles long and 8 miles wide, near the flanks of the foothills on the north side of the Tanana Valley in central Alaska. The southern part of this belt is about 11 miles west of the city of Fairbanks, and the northern extremity is about 30 miles to the northeast.

Fairbanks, a city of about 20,000 population, is the transportation and supply hub of central Alaska. The Alaska Railroad, which is 468 miles in length, connects Fairbanks with Pacific Ocean terminals at Seward, Whittier, and Anchorage. Oceangoing vessels make regular trips at frequent intervals between these ports and Seattle, Wash. Other freight routes to Fairbanks include highways from Anchorage and Valdez and the Trans-Canada-Alaska Highway. The International Airport at Fairbanks accommodates jet aircraft that provide connections with both national and international carriers. Numerous small air carriers that service the central and arctic regions of Alaska headquarter at Fairbanks. The Chena River links Fairbanks with the Yukon-Tanana River waterway system during open season.

The mines and prospects are linked to Fairbanks by a network of service roads and trails that connect with the arterial highway system of central Alaska. The service roads and trails are usable throughout the year except during spring breakup and during periods of exceptionally heavy snow accumulation.

PHYSICAL FEATURES AND CLIMATE

Topographically, the Fairbanks mining district is a region of low hills and broad valleys with meandering streams. The hills are nearly flat-topped and have rounded contours and irregular ridge patterns. Meander ridge lines are formed by numerous gulches and small streams that cut the flanks of the hills. The most prominent landmarks are Ester Dome and Pedro Dome, 2,364 and 2,600 feet, respectively, above sea level. Valley floors range in altitude from 600 to 1,200 feet.

In places, trees grow upon the entire slope of the hills, but only on the lower slopes do they reach a size adequate for mine timber or logging. Spruce, birch, poplar, and tamarack grow in the region, but spruce is the most important as a local source for lumber. Thickets of alder, willow, dwarf birch, and berry bushes grow amid trees and along stream courses. Moss and grass grow on the slopes, and the ridges are covered with mossy tundra and several types of berry bushes and vines.

The climate in the Fairbanks area is subarctic with long cold winters and short warm summers. The mean temperature is -7° F for the 3 winter months and 57° F for the 3 summer months. The temperature is frequently -40° to -65° F during December, January, and February.

The annual rainfall of about 12 inches is comparable with that of a semi-arid climate. The average snowfall is about 50 inches. Most of the soil,

gravel, and bedrock in the region is perennially frozen (permafrost). The seasonal thaw ranges from a few inches in areas where the ground is covered by moss to several feet in areas where the moss has been removed. Permafrost and the usually heavy cover of overburden and vegetation handicap prospecting and complicate mining.

HISTORY AND PRODUCTION

. The 1902 discovery of the rich gold-placer deposits and the subsequent rapid development of placer mining stimulated the search for the bedrock sources of placer gold in the Fairbanks mining district. The first gold quartz claim was located in 1903, and numerous other discoveries were made shortly afterward. The gold-bearing quartz veins were not bonanzas, and lode mining developed slowly. The first stamp mill was built in 1909, and the first lode gold was produced in 1910. In 1913, six mills were operating, and more than 12,000 tons of gold ore was milled. Gold mining declined during World War I, and from 1915 to 1923 the mining of lode-gold deposits continued at less than 2,000 tons per year. Completion of the Alaska Railroad in 1923 provided a direct bulk-freight route from the coast to Fairbanks. Lode mining increased to 5,000 to 6,000 tons per year in the 1930's. The increase in the price of gold from \$20.67 to \$35.00 per fine troy ounce in 1934 resulted in an annual production of over 11,500 fine troy ounces by the late 1930's. During this period, production of lode gold exceeded the gross production from all placer mines in the district except that of dredges. In 1942, the production of lode gold was stopped by an executive order that closed gold mines. After World War II, attempts were made to resume operations at some of the mines, but in most cases, increased costs made mining unprofitable. At various times during the past several years, one and sometimes two lode mines have operated for short periods, but at no time at a scale comparable with that prior to 1942.

The total production from lode-gold deposits in the district is about 241,000 fine troy ounces from ore that averages about 1.32 fine ounces per ton. The most productive sources of lode gold are veins a few inches to 3 feet wide. Although there have been as many as 10 to 12 mines operating in the district at one time, the largest single mine produced about 40 tons of ore per 24-hour day.

LANDS

Surface and mineral rights to land in the Fairbanks district are administered by one of the following:

A. Bureau of Land Management (U.S. Department of the Interior)--Lands that are under the jurisdiction of the Bureau of Land Management comprise two main classifications:

1. Public domain. The only public lands available in the immediate vicinity of the lode mining areas is the northeast extremity of the Pedro Dome Cleary area. This land is subject to location under Federal mining laws and is regulated further by Alaska statutes.

2. Lands withdrawn from mineral location that are used by some Federal agency. These lands are mainly military reservations and lands used by the Federal Aviation Agency (FAA) and National Aeronautics and Space Administration (NASA). Scattered small tracts are used by other Federal agencies. Some tracts are amidst land that is mineral in character.

B. Division of Lands (State of Alaska)--Under the Statehood Act, the State of Alaska selected almost all of the public domain in the Fairbanks mining district for conversion to State title. The State of Alaska cannot confer mineral rights in the land; mineral right on State land is leased from the State. All unappropriated State lands in the district are administered by the Division of Lands.

C. Private (Individuals, Companies, and Associations)--There is varied ownership of patented lode claims in the district; the largest blocks of patented claims are held by Keystone Mines, Inc., of Fairbanks, and Mrs. W. Bartholomae of Santa Ana, Calif. The ownership of the remaining patented lode claims is vested in many individuals.

There are many unpatented lode claims that were staked under Federal law prior to State selection. The holders of these claims can retain their rights as long as they perform the necessary assessment work and conform with Federal and State mining laws. As soon as a right is relinquished, the claim immediately converts to State ownership. Most of the lode mineral rights in the Fairbanks district are held by unpatented lode claims. There are many owners of small groups of unpatented claims.

GENERAL GEOLOGY AND STRUCTURE

The general geology of the Fairbanks mining district is summarily described from various publications of the U.S. Geological Survey.

General features of the geology of the Fairbanks district are relatively simple, but the detailed structure and stratigraphy are complex. The scarcity of outcrops makes detailed analysis difficult. Metamorphic rocks of sedimentary origin are predominant and consist mostly of quartzite schist and quartz-mica schist and some massive quartzites. Along with these rocks are some hornblende schists. These largely schistose rocks are grouped under the name Birch Creek Schist and are probably of Precambrian age. The continuity of the schists is broken by some irregular belts of crystalline limestones and calcareous rocks that are intensely altered with calcite replaced by secondary minerals. Some calcareous schists are associated with the limestones. The limestones and calcareous rocks appear to form a definite horizon in the metamorphic series.

The intrusive rocks in the district include a few belts of granite gneiss that were intruded before deformation produced schistosity. Extensive stocks of diorite and granitic rocks as well as dikes of the same or similar composition are important. There appear to be three epochs of intrusion. The earliest intrusive rock is quartz diorite, which is followed by porphyritic granite. These two types of intrusives occur both as stocks and dikes. Both are cut by

acidic dikes that consist chiefly of quartz and feldspar; namely, quartz monzonite. Except for the gneiss, the intrusives are probably not older than Lower Cretaceous, and some may be Late Upper Cretaceous and some may be Eocene.

The distribution of calcareous rocks indicates an original eastward-trending structure for the sedimentary rocks; this structure has been modified by later profound deformation that has rendered all the rocks schistose. Complex structures are the end result of several periods of deformation that took place in Paleozoic and Mesozoic time. There was also an epoch of deformation in Eocene time. These disturbances did not affect the massive granites for, since their intrusion, the movements are recorded only as fissures, faults, and joints. The distribution of some calcareous rocks indicates certain larger folds, and superimposed on these folds are an infinite number of minor closed folds, which are chiefly overturned to the northwest. In the east half of the district, the schistosity strikes east and northeast. To the west, this trend gradually swings to the southwest. In the Ester Dome area, the dominating trend of schistosity is north and northwest. There are many local variations to the average trends of the schistosity.

The large stocks of granite and quartz diorite trend from N 70° E, to east. The stocks are intruded parallel to what is believed to be the original structure rather than to that of the foliation. Adjacent to the stocks, the foliation of the schists is generally parallel to the intrusives. Far more irregular are the strikes of the acidic dikes, which in part follow the foliation and in part parallel the system of fissures occupied by the metalliferous veins.

The metalliferous veins in the district mainly occur in two areas, the Ester Dome area and the Pedro Dome-Cleary area. Some discoveries have been made in a thrust zone in the Gilmore Dome-Engineer Creek area, but very little lode gold has been produced from it.

In the Ester Dome area, the cleavage of the rocks indicates an anticlinal fold with the main axis trending nearly south. The cleavage of the schist on the flanks has relatively low dips to the east and west except where the rocks are broken by later fractures, which is the rule rather than the exception.

The rocks in the Pedro Dome-Cleary area are distorted by a series of highly oppressed folds with axes that trend approximately east. A very distinct axis of one of these folds trends a few degrees north of east and passes just north of Pedro Dome and extends eastward along the north side of Fairbanks Creek. The intrusive quartz diorite of Pedro Dome apparently came up along a break near the crest of this fold, which is not symmetrical. The cleavage of the beds to the south dips 10° to 20° south, and the cleavage of the beds to the north dips 30° to 50° north.

The anticlinal structure of the Pedro Dome-Cleary area is intricately cut by a double series of closely spaced faults, some of which are of considerable magnitude. The main fractures trend easterly, and the less conspicuous faults strike nearly north. The major faults in the Ester Dome area strike either almost parallel to the axis of the fold (north) or perpendicular to it (east).

Much fracturing along both series of breaks took place before the mineralizing solutions came in because the principal veins of the two areas follow the characteristic structural lines of the district. On Ester Dome practically all the veins strike within a few degrees of north, and near Pedro Dome most of the veins strike northwest.

ORE DEPOSITS

The general character of the gold-lode deposits is summarized and quoted from work by James M. Hill of the U.S. Geological Survey (2):²

The gold lodes of the Fairbanks district are fissure veins or lodes, cutting various types of schists of pre-Cambrian age, usually in fairly close proximity to bodies of intrusive acidic igneous rock. The narrower veins, from 2 inches to 3 feet wide, are by far the most productive source of lode gold so far developed. In a few mines, notably the Billy Sunday, Newsboy, and Hi-Yu, silicified schist in which there are closely spaced quartz veinlets, constituting 'lodes' in the strict sense, has been found sufficiently rich to mine over widths of 8 to 12 feet. There are several broad zones of silicified, sericitized schist which have been considered as possible gold lodes. Some of these, such as the Ryan Lode, are badly crushed and faulted. In the Ryan Lode, the zone is 40 to 70 feet wide, in the Zimmerman cut 60 feet wide, and at the Faulkner property 75 feet wide. . . .

The strikes and dips of the principal veins and faults show a great difference in major trend lines between the Pedro Dome-Cleary area and the Ester Dome area. In the Pedro Dome-Cleary area, practically all the principal veins strike between N 60° W and west, and dip 45° to 80° south. There are a few veins that strike N 25° E to N 45° E with dips 70° to 75° west. The major postmineral faulting in the Pedro Dome area likewise has a west-northwest trend almost parallel to the trend of mineralization, but there are also numerous faults striking in almost every direction.

In the Ester Dome area, the greatest number of veins strike between north and N 40° E, with dips both east and west 45° to 80°. There are, however, some veins that strike northwest; but all of these dip to the northeast. The postmineral faults on Ester Dome are more regular than those in the Pedro Dome-Cleary area with strikes N 35° W and N 50° E, and dips 45° to 70° east and 45° to 80° east.

James M. Hill describes the vein filling and vein structure of the gold-lode deposits as follows (2):

A study of thin sections and polished faces of vein quartz shows conclusively that there have been at least four periods of introduction of silica. The earliest deposit was a rather coarsely

²Underlined numbers in parentheses refer to items in the bibliography at the end of this report.

crystalline white quartz that does not appear to have been accomplished by metallic minerals. This quartz was later brecciated and crushed by earth movements. The next quartz was deposited in somewhat smaller crystals in the breccia of the earlier quartz with a little pyrite and some free gold. These second veins were again crushed and later healed with still finer grained grayish or white quartz accompanied by the sulphides and free gold which made the bonanza ores of the lodes. Still later there was some reopening of the veins and deposition of small dog-tooth crystals of white quartz in open fractures which were not entirely filled. This quartz apparently represents the last of the mineralizing solutions and does not appear to have carried any metallic minerals.

Most of the veins cut directly across the schistosity and occupy persistent, relatively straight fracture planes. In places, however, the schist is cut in many directions by stringers of quartz. There are some veins that in general are nearly parallel to the schistosity, but they are rare and usually of small size, both in thickness and in lateral extent. At most places these veins parallel to schistosity are offshoots from the larger veins that cut the formations and are likely to carry a galena-jamesonite heavy sulphide ore rather than the usual quartz, sulphide, and free gold ore. In detail these veins cut across the planes of schistosity.

In most veins there is a rough sheeting due to crushing and recementation by quartz of different character. There may have been an original banded deposition of earlier quartz, as indicated by fragments of terminated crystals, but such banding has been destroyed by later brecciation, though the barren quartz deposited during the fourth or final stage of mineralization in places has escaped crushing.

The third stage of silica deposition appears to have been of greatest importance in the formation of ore. The mineralizing agent, in addition to silica, carried a considerable burden of iron, arsenic, antimony, and sulphur, together with gold and some lead and bismuth. Apparently this mineralization was not so wide-spread as that of the earlier periods, for it is only in places of more intense brecciation of the two older phases of quartz that sulphide gold quartz of this third stage is strongly developed. There are many veins of low to medium grade ore, but the relatively few bonanza ore bodies appear to have been formed only when the third stage of mineralization was most intense.

Postmineral movement has been widespread, and almost everywhere the veins are accompanied by clay selvages and gouge on the walls. It is rare to find ore frozen to the wall rock. Postmineral brecciation of the quartz and country rock has permitted ground water to

penetrate along certain parts of veins to the greatest depths attained by the mine openings.

Oxidation products, chiefly limonite and the yellowish-green arsenical and antimonial oxides and occasionally manganese oxide, can be seen at the lowest levels of the Cleary Hill, Mohawk, and Hi-Yu mines. However, a relatively small part of the vein filling has been completely oxidized, even in the shallow surface pits on outcrops of the veins.

The schist wall rocks near the veins have been altered to a surprisingly small extent, except in the broad zones of crushing and silicification such as are found at the Faulkner property, the Zimmerman cut, and the Pedro Dome fault. In these broad zones the schist and intrusive rocks have been sericitized and silicified so as to be hardly recognizable. Along the typical veins, which are from one to three feet wide, the enclosing rocks have been bleached to some extent by the formation of sericite and a very little calcite and by the introduction of silica, though silicification is not noticeable at all places. Small cubical crystals of pyrite are sparingly disseminated in some of the more highly altered wall rocks.

The following is a list of minerals associated with the ores of the Fairbanks district:³ Argentite, arsenopyrite, bismuth, boulangerite, calcite, cervantite, chalcocite, chalcopyrite, covellite, galena, gold, jamesonite, limonite, lollingite, manganese oxide, mariposite, pyrite, quartz, scorodite, sphalerite, stibiconite, stibnite, scheelite, and tetrahedrite.

RESERVES

The only proven lode-gold reserves in the district are reported to be in the Keystone Mines, Inc., holdings in the vicinity of the Hi-Yu, McCarty, and Homestake mines, and at the Ryan Lode on Ester Dome. Such past producers as the Cleary Hill, Hi-Yu, McCarty (Henry Ford), Robinson (Rose), Soo, Nordale, and Newsboy in the Pedro Dome-Cleary area, and the Mohawk, Ready Bullion, Grant, Blud Bird, Combination, Look Out, Clipper, and Sanford in the Ester Dome area, depleted their proven reserves during and prior to the gold mine closure period of World War II. Transitory attempts were made to reopen some of these properties after the close of the war; some of them reached the production stage, but before long they closed because of continually increasing costs, insufficient development, and the inability to get adequate financing.

The lode-gold belt in the Fairbanks mining district is strong and persistent, and average values range from 0.28 to 2.30 troy ounces per ton; high-grade pay shoots often average 10 ounces per ton. The lodes were doubtless the source for the high-grade placers that produced over 7,800,000 ounces or

³Underlines designate minerals that are widespread; other minerals have been identified but are sparse.

38 percent of the placer gold from Alaska. Some geologists contend that the veins were truncated during the time the placers were formed, and what now remains are the small remnants of the onetime bonanza pay shoots. In the Pedro Dome-Cleary area, the difference in elevation of the highest and lowest underground workings is over 1,200 feet. The 600 level in the Cleary Hill mine is probably the lowest limit to which any pay shoot was mined in the area, and ore was in sight on this level when the mine closed down during World War II. A similar situation exists at Ester Dome area where there is also a difference of over 1,000 feet between the lowest and highest underground workings. Because of these conditions, it is believed not unreasonable to infer gold-lode resources equivalent to half the total placer and lode production. The Pedro Dome-Cleary area is an arcuate mineralized zone about 8 miles long and 1 to 2 miles wide with 78 gold lode deposits; of these deposits, 38 have been productive and 40 are prospects. The Ester Dome area is roughly circular, about 5 miles in diameter, and has 48 gold lode deposits; of these deposits, 27 have been productive and 21 are prospects. The bulk of the lode gold produced in the entire district came from 28 mines. The total lode-gold production of some 241,000 fine troy ounces does not appear to demonstrate the full capability of the district. The sequence of geologic events that formed the veins indicates that the veins are possibly deep seated. That the auriferous veins and all the igneous rocks were not contemporaneous implies that certain veins may cut certain of the igneous rocks. On this basis, there appears to be no indisputable reason to conclude that the lower limit of the veins should terminate above the surface of the granitic intrusives. The areal extent, difference in elevation and frequency of occurrence of the gold-bearing veins, and the possibility that the veins are deep seated appear to justify inferring a lode-gold resource that approximates 4,000,000 fine troy ounces. In the absence of the detailed data needed to evaluate the numerous deposits, the above estimate must be considered to indicate only the order of magnitude of the lode-gold resource.

MINING AND MILLING

Hand-mining methods introduced into the district at the outset of lode activity have persisted with only slight mechanization. The highest grade ores occur in narrow veins a few inches to 3 feet wide that are transected by numerous faults. The size of the veins and the general multiplicity of faults doubtless prevents extensive mine mechanization, but ore breaking and handling and roof support could be improved with modern drills, trammers, muckers, and roof bolts. The use of modern equipment underground in conjunction with a well-planned mining system would doubtless result in more efficient ore extraction.

The antiquated mills and other surface plant equipment were outdated years ago. Some of the first ore-processing equipment used in the district, such as gravity and piston stamps and Chilean mills powered by obsolete diesel-electric plants, are used to this day. The gravity stamps at the Hi-Yu mill have a capacity of about 40 tons per 24 hours; this is the highest capacity mill in the district. The Cleary Hill stamp mill, the second largest mill, has a capacity of about 20 tons per 24 hours. Other mills in the district with capacities that range from 5 to 20 tons per 24 hours use such grinding

equipment as a Lane Chilean mill, Gibson rod mill, Herman pebble mill, and Nissen stamps. Portable ball mills with capacities limited to 5 to 8 tons per day have been used occasionally on a one- to two-man operation. In general, the average production rate for the district is about 0.8 ton per man per day. Minimum mill heads, prior to and at the start of World War II, ranged from \$17 to \$20 per ton for simple amalgamation at the largest and most consistent producing mines in the district.

With the exception of the Cleary Hill mine, McCarty (Henry Ford) mine, Hi-Yu mine, and the Ryan Lode, unit-cost records and mine maps are cursory or practically nonexistent. This is not an unusual situation for small mines for which the only records the operators kept are for tax purposes.

CONDITION OF MINES, MILLS, AND OTHER SURFACE STRUCTURES

Most of the underground workings in the district are inaccessible, particularly the mines that were the main producers. Shafts are iced or flooded, and the portals of adits are also caved or iced. Sections of the mines where stopes break through to the surface are also iced and caved. The Kawalita claim of Keystone Mines, Inc., was worked by open pit methods during the mid to late 1950's. From 1963 to late 1966, the same vein was mined from an inclined shaft by underground methods. At the present time, 1973, these workings are flooded.

Ice provides good natural support and is not difficult to remove. After the ice is removed, workings usually stand very well. Where caving has preceded icing, the rock and timber locked in the ice makes reopening difficult. Underground workings that are filled with ice only are less costly to reopen than caved workings that are iced.

In general, most surface structures, such as headframes, hoist houses, shops, warehouses, and coarse ore bins, are in poor condition, and many are not now usable. Most of the mill buildings are in poor shape but still provide cover for equipment. Although much of the milling equipment is obsolete and in disrepair, it is fairly well preserved due to the semiarid climate. There has been some looting and wanton destruction at some properties.

ESTER DOME AREA

Structural control confines the most intense metallization to the southeast flank of Ester Dome (fig. 2). The principal gold-bearing deposits generally occur in a belt along and near the crest of a low northward-trending anticline. The cleavage of the schist dips at low angles to the southeast and northwest along the flanks of this anticline. Most of the gold veins strike north to northeast with dips both east and west 45° to 80° . Some veins strike northwest but dip to the northeast.

The principal producing lode-gold mines were the Mohawk, Blue Bird, Combination, Little Eva, St. Paul, Grant, Sanford, Clipper, Look Out, and Ready Bullion; lesser amounts were produced from the Bondholder, Mickley, Little Flower, and Adler. Although very little gold was produced from the

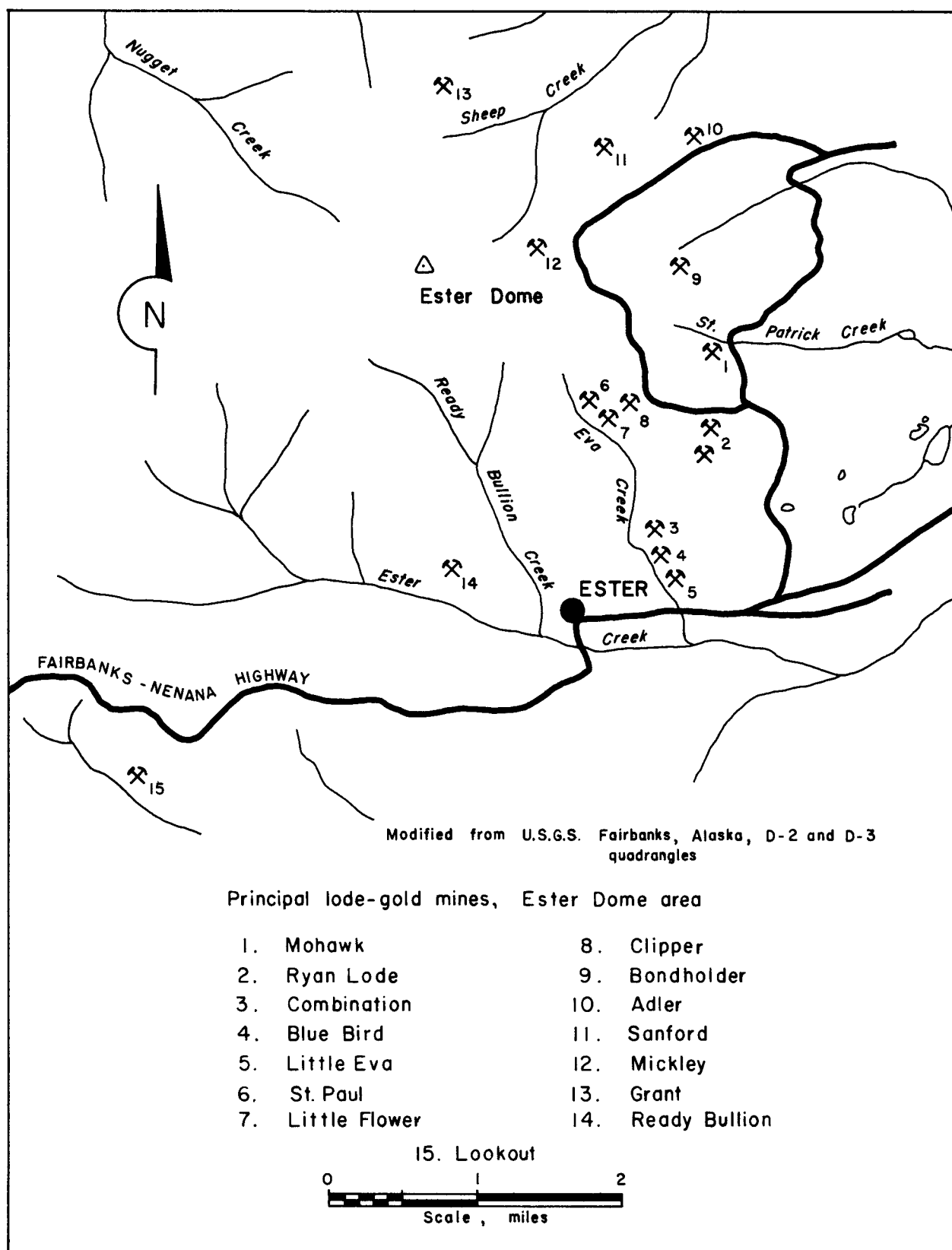


FIGURE 2. - Ester Dome, Fairbanks district, Alaska.

Ryan Lode, considerable exploration and development work indicates that it has a possible open pit potential. Modern rock fragmentation, materials handling, and beneficiation techniques as well as modern equipment appear to justify a renewed investigation into the open-pit potential of the Ryan Lode and surrounding area.

PEDRO DOME-CLEARY AREA

The most consistent production in the Pedro Dome-Cleary area (figs. 3-4) was from the Hi-Yu, McCarty (Henry Ford), and Cleary Hill mines. Less important producers were the Homestake, Chatham, Tolovana, Newsboy, Newsboy Extension, Wackwitz, Robinson (Rose), Rainbow, Kawalita, Soo, and Wyoming mines. At various times, numerous small prospects provided feed to operating mills that would accept custom ores. With the exception of the Newsboy, Newsboy Extension, and segments of the Hi-Yu, the average width of the veins would not exceed 2 feet, and the average tenor of ore milled, over a period of 25 years, would approximate 1.3 troy ounces per ton. In places, the Hi-Yu veins exceed 3 feet in width, but the average tenor is approximately 1.0 ounce per ton. The Newsboy and Newsboy Extension veins are 8 to 10 feet wide in places, but the tenor probably does not exceed 0.2 to 0.3 ounce per ton.

Most of the productive veins in the area strike northwest and dip 45° to 80° south, except the Newsboy, Newsboy Extension, Robinson (Rose), and Wackwitz, which trend northeast and dip about 70° west, and the Tolovana and Wyoming, which trend east-west and dip 50° to 60° south.

Grouping the various properties in the Pedro Dome-Cleary area so that several mines could be worked from a common entry to feed a centrally located mill should save capital investment as well as development and operating costs. A constant source of mill feed from the narrow veins has always been the major mining problem. Increasing the number of stoping faces and selectively working several veins and high-grade pay shoots from a common entry would be a practical solution for providing a constant source of mill feed. The freezing of underground openings should be considered as a possible means of support. Subfreezing air can be circulated during the cold weather months to freeze selected areas within the mine. The extraction of ore from areas supported by this method can be scheduled during the winter months.

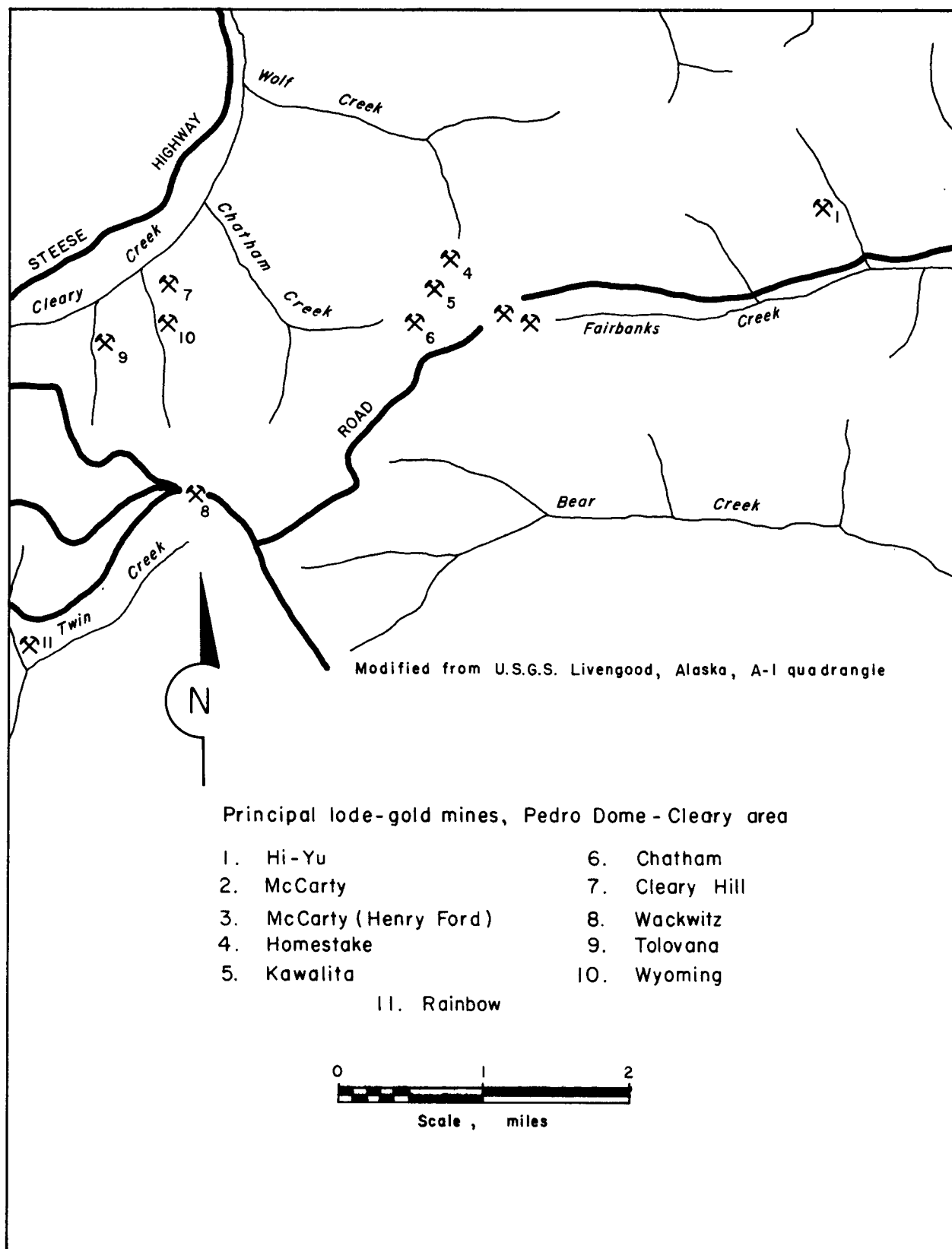


FIGURE 3. - Pedro Dome-Cleary area (east), Fairbanks district, Alaska.

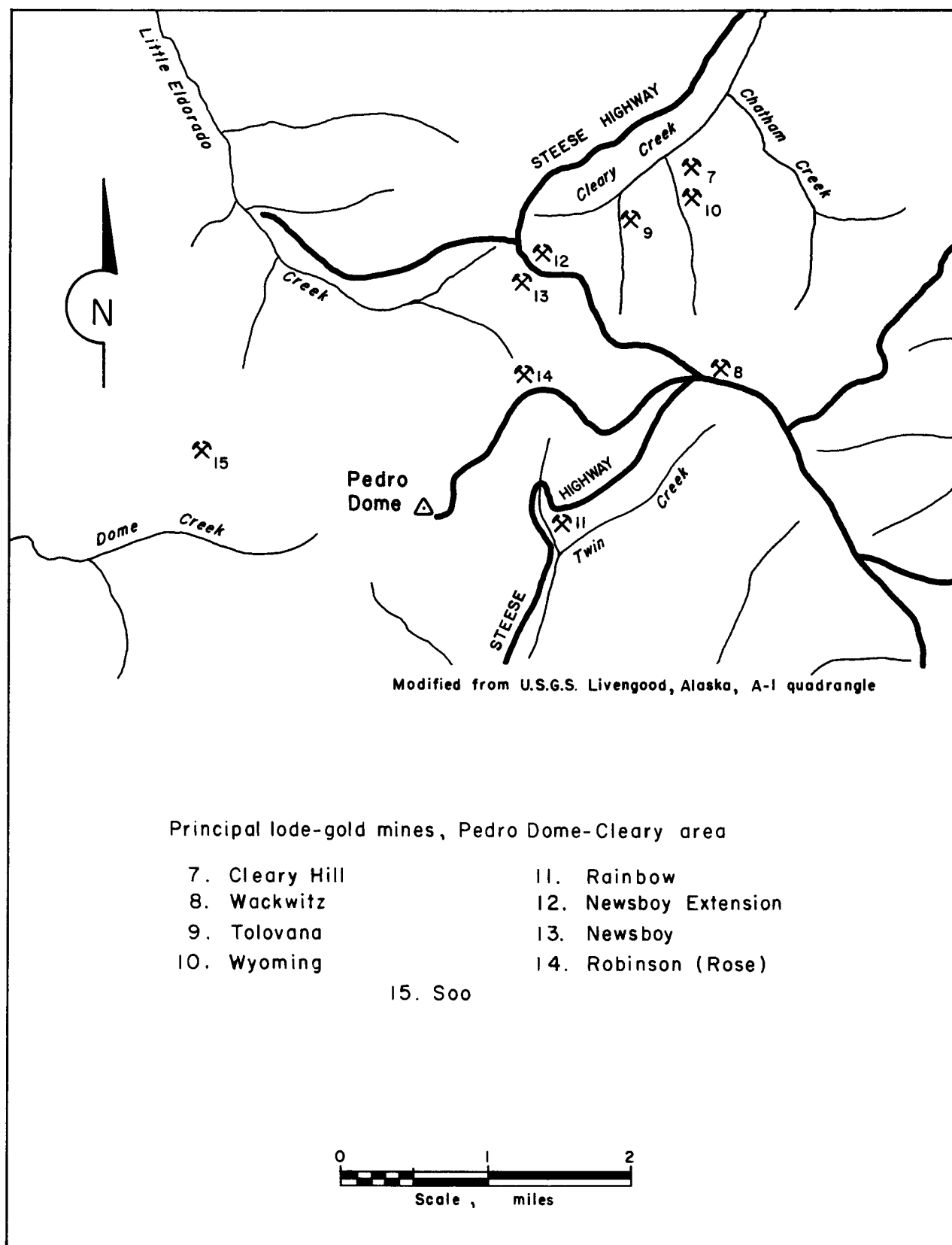


FIGURE 4. - Pedro Dome-Cleary area (west), Fairbanks district, Alaska.

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