Northern Lights Exploration Co., Inc.

724 Cedar Street
Anchorage, Alaska 99501
(907) 272-7252

R. W. Voss
President
729 Ocean View Dr.
SRA Box 1450A
Anchorage, AK 99502
(907) 344-1492

C. Girard Davidson
Attorney-At-Law
Commonwealth Building
Portland, Ore. 97204
(503) 223-3800

15 March 1974

ORIGINAL COPY
O. M. E.
RECEIVED
MAR 25 1974
INITIALS | CODE
HK

U.S. Department of the Interior
Geological Survey
Office of Minerals Exploration
345 Middlefield Road
Menlo Park, California 94025

Dear Sir:

Received your letter of March 12, 1974 regarding our application for funding through the OME program.

Believe there may be a misinterpretation regarding our application regarding the intent of our exploration. To clarify this: We are making exploration in a specific area, which has already been identified as the target area(s) on Shotgun Creek at the fissure vein and on the stream identified as "No Name" between the fissure vein and "Horseshoe Ridge". We have already expended considerable time, effort and money to do this. What needs to be done now is a drilling program to determine the extent of the concealed ore body (probably sulfide). While considerable work is still to be done, considering the size of our property, the application was submitted for this purpose.

It is disheartening news to learn that all OME funds for the FY ending June 30, 1974 has been expended. We have been informed informally that there was only about $125,000.00 available, so it is understandable to be advised that the funding has been exhausted. The fact that it is likely that no funding will be appropriated in the future is somewhat alarming, especially when considering (1) the metal-mineral shortage; and (2) the fact that loans to Russia for exploration of Siberia are being made or considered. Am enclosing a copy of Saturday Review (Jan.74) article regarding this. In addition it is interesting to note that the Wall Street Journal noted the mineral crisis as here now. We seem to have a paradox here or at least a lack of interest at appropriate levels. It would appear that the Western Region, which could be highly productive, is sadly lacking for appropriated funding. This is undoubtedly the major reason that Americans must seek joint ventures, or outright sale of their properties to foreign interests.

Thank you for your letter and courteous reply. It is sincerely hoped that your office will receive some special considerations in appropriate funding.

Sincerely yours,

R. W. Voss
President

cc:
C. Girard Davidson
H. Bryant
Sen. Ted Stevens
Rep. Don Young

RECEIVED
MAR 18 1974
OFFICE OF MINERALS EXPLORATION
U.S. GEOLOGICAL SURVEY
MENLO PARK, CALIF.

March 15, 1974

The Honorable Ted Stevens
United States Senator (Alaska)
United States Senate
Washington, D. C. 20510

Dear Senator Stevens:

The attached information is forwarded to you as a matter of keeping you informed.

Believe the letter to the OME Office in Menlo Park and their letter of March 12, 1974 spells everything out pretty clearly.

It is sincerely hoped that you will be able to bring this to the attention of your colleagues and hopefully the Western Region will receive a special appropriation this year and a substantial and realistic one for the coming fiscal year.

Sincerely yours,

R. W. Voss
President

cc:
C. Girard Davidson
H. Bryant
OME, Menlo Park, Calif.

Bank Holds Up Loans To Soviets

ADT 3/12/74

WASHINGTON (UPI) — The Export - Import Bank said today it has held up processing dozens of new loans to the Soviet Union and three other Communist countries pending a ruling on their legality.

Bank officials said the loans to Russia, Poland, Romania and Yugoslavia were suspended until a decision is made by the General Accounting Office on whether legal requirements had been met.

The bank is allowed to extend financing credits to Communist countries if they are deemed by the White House to be in the national interest.

 Saturday Review 1/26/74

Today's Big Red Market

by Harry Schwartz

For veteran Russia watchers in this country, there is a sense of *déjà vu* about the current boom in Soviet-American trade and about the even greater boom in expectations about that trade's future. There is much in the recent atmosphere that is reminiscent of the late 1920s and early 1930s, when American industry contributed so much to helping realize Stalin's initial program of Soviet industrialization. Once again we have enthusiastic meetings of American businessmen who cheer the messengers of Moscow bringing the good news that the Kremlin wants to buy. Once again Red Square has become a sort of Times Square for top American executives. And once again machinery manufactured in Ohio and Pennsylvania and New York and even California is being installed in Kharkov and Leningrad and Omsk and, no doubt, even Tomsk. It is rumored that forward-looking planners at Harvard Business School are suggesting that the study of the Russian language be made a required course for the M.B.A.

The bare statistics tell the dizzying tale plainly enough. In 1971 the United States sold about $160 million worth of goods to the Soviet Union. In 1972 that figure jumped to almost $550 million; in 1973, if the pace set from January to July was maintained the rest of the year, exports could approach $1.5 billion. The optimists argue that this is only the beginning and that by 1980 even the 1973 figures will look picayune. Now is the time to get on the Moscow trade bandwagon for fun and profit, they argue.

The optimists could prove to be correct, and certainly few major American industrial corporations today are without salesmen and market researchers probing more or less actively for Russian orders. However, there is also restraint and caution. And heed is being paid to pessimists who see the Russian trade expansion as a semi-mirage for the longer-run future and who also worry about the political backlash on their companies of too close and too extensive economic relations with Moscow.

The skeptics' case has both economic and political foundations. Economically, the doubters note that most of the recent export boom derives from last year's gigantic Soviet grain purchases here. With Moscow claiming a record 1973 grain harvest, Soviet buying agents are not likely to appear again soon in the American wheat market with the same almost insatiable appetite that they displayed in mid-1972.

> "It is hard to see how multi-billion-dollar investments in Siberian natural gas would help make the U.S. self-sufficient in energy."

Even more, the skeptics worry about the colossal imbalance between recent Soviet purchases here and sales to this country. U.S. imports from Russia have been rising, but it would be surprising if in 1973 Soviet goods arriving here totaled very much more than $150 million, that is, little more than 10 percent of indicated 1973 U.S. exports. For the moment, Moscow is making up this huge gap by a combination of American credits plus payments in cash derived from Soviet sales of gold and other commodities elsewhere. Such a huge export-import imbalance as displayed in 1973 Soviet-American trade hardly seems supportable very long.

But the political hurdles ahead seem even more daunting to many observers than the economic problems. The simple fact is that many Americans still neither like nor trust the Soviet Union, and their sentiments are widely shared in Congress. The strength of these suspicions has been demonstrated vividly by Sen. Henry Jackson's success in frustrating the Nixon administration's efforts to deliver its promise to Moscow to give Soviet goods arriving here most-favored-nation tariff treatment.

Unpromising as the Soviet-American political atmosphere was regarding trade before the October Middle East war, that conflict worsened the situation. The brilliant display of the capability of Soviet advanced weapons during the conflict aroused new fears among many Americans and raised pointed questions about the wisdom of selling Moscow the American technology in computers and other fields that the Kremlin so badly wants.

But it is the Arab embargo on oil for the United States that has raised the most political worries before the most enthusiastic proponents of close Soviet-American economic cooperation. That is because the huge projects Moscow wants involve U.S. credits in the billions of dollars for developing Soviet natural-gas fields in frozen Siberia and for building the infrastructure required to carry that natural gas to markets. Moscow proposes to repay those credits by natural-gas deliveries after 1980.

But those promises seem less convincing now than earlier in this era. The spectacle of the American-owned oil giant Aramco being used as Saudi Arabia's prime servant in implementing and enforcing the Arab oil boycott against this country has been traumatic. If the Arabs, relatively weak militarily, can deny the fruits of American oil investment in the Middle East to the United States, what would stop the Soviet Union in the 1980s from reneging on its promises of natural-gas deliveries if new economic or political developments are made that seem advantageous to Moscow?

Even before the Yom Kippur war, the Nixon administration was being cautious about the Siberian natural-gas projects, showing nervousness about the large investments required and demanding that Moscow provide much more information than the Kremlin is accustomed to supply foreigners about its economic projects.

But these days President Nixon's line is that the United States must become self-sufficient in energy and not be dependent upon anyone else's whim. If that is meant seriously, it is hard to see how multi-billion-dollar investments in Siberian natural gas would help make the United States self-sufficient in energy. Couldn't the same money be used to better and more secure advantage in developing U.S. coal, oil, natural gas, shale, and other similar resources, either in the lower forty-eight states or in Alaska?

It may be that the Arabs will relent, that the chill in Moscow-Washington relations will warm up as the Middle East war recedes into history. But at the moment—though the trade statistics are still rocketing and though new contracts are being signed almost every week—the future of Soviet-American economic relations seems very cloudy. And the pessimists recall that after the boom of the late 1920s and early 1930s there was a sharp drop in the mid- and late 1930s. Will history repeat in the mid- and late 1970s? □

Harry Schwartz is a longtime student of the Soviet economy and Soviet-American trade.

Copied from Wall Street Journal, Wednesday, December 26, 1973

WHAT NEXT? America's Dependence On Imported Metal Seen Leading To New Crisis. The Less-Developed Countries May Boost Prices Sharply; New Foreign Policy Urged --- An Ever-Increasing Reliance.

By Richard J. Levine - Staff Reporter of The Wall Street Journal.

WASHINGTON - After the energy crisis could come a metals crisis.

That grim possibility is beginning to haunt officials here as the Arab oil embargo stirs new fears about the nation's growing dependence on foreign supplies of many crucial mineral ores.

At this point, the concern is centered among middle-echelon bureaucrats, private economists and industry executives. But it is starting to spread to the ranks of government policymakers, reaching in recent days the offices of Interior Secretary Rogers Morton, Federal Reserve Board Chairman Arthur Burns and energy czar William Simon.

What worries these men is the possibility that the Arab oil embargo may give dangerous ideas to the less-developed countries in Africa, Asia and Latin America that supply the U.S. with minerals. They are concerned that these so-called third-world nations-viewing the Arabs' use of oil to force Israeli withdrawl from occupied lands-may decide to use their mineral wealth not to achieve political ends but to jack up their economic positions. The result could be skyrocketing prices and dwindling supplies on world markets.

"Recent events are very distrubing," says Mr. Burns, "What happened in oil could happen in copper and other raw materials," he adds. Mr. Morton suggests that, unless protective steps are taken, such as maintaining stockpiles, the U.S. could face a "minerals crisis and a materials crisis." There is "no reason why the group of countries that supply most of our bauxite (the ore from which aluminum is produced) can't get together the way the (oil-producing) countries got together on the price of oil." he says. Jamaica and Surinam are the original source of about two-thirds of the aluminum used in the U.S., with Canada and Australia also major producers.

Perhaps the man most responsible for spreading the word about the metals-dependence problem has been C. Fred Bergsten, an international-economics expert at the Brookings Institution who formerly worked for Henry Kissinger on the National Security Council staff. Mr. Bergsten outlined the problem in an article last summer in Foreign Policy magazine entitled, "The Threat From the Third World." It drew little attention at the time, but then came the oil embargo. Recently, Mr. Bergsten has been busy updating his ideas before congressional committees.

"While the oil situation itself must be the focus of policy attention at the moment, we must recognize its far broader implications for the longer run," he says. "Perhaps the broadest lesson to be learned...is that countries will adopt extreme, even wholly irrational, policies when frustrated repeatedly in achieving their most cherished aspirations."

Underlying the concern of Mr. Bergsten and others are some harsh facts about the ever-increasing reliance of the U.S. on foreign metals since it became a net importer in the 1920s.

According to the Interior Department, the U.S. already depends on imports for more than half its supply of six of 13 basic raw materials required by an industrialized society (aluminum, chromium, manganese, nickel, tin, and zinc). By 1985, the country will also depend on imports for more than half its iron, lead and tungsten. And by the year 2000, its imports will have to supply more than half its copper, potassium and sulphur. (The 13th material is phosphorus, which is so abundant in the U.S. that imports even in the year 2000 are expected to be negligible).

INCREASING DEPENDENCE

Viewed another way, the projections suggest the U.S. may have to import $18 billion of metals a year by 1985 and $44 billion by the turn of the century, up from only $5 billion in 1970. "What kind of an economy can stand that kind of pressure on its balance of payments?" asks an Interior Department planner.

At the department's Bureau of Mines, Paul Zinner, assistant director for planning, says the bureau has seen the metals problem coming for 20 years but has been unable to generate much high-level interest. "Since 1953, we've been saying annually we've got to do something about it. But nothing's happened because there's been no crisis. When you find you can't buy an auto because industry can't get materials, you'll get concerned."

As that concern builds, it is likely to be accompanied by the realization that the increasing dependence on overseas metals supplies must dictate changes in American foreign policy. Most obviously, in the view of some analysts, it will force Washington to lavish more attention and money on the less developed nations than in the past. "When we awaken to an oil crisis," says Mr. Bergsten, "we realize how vital to us are Nigeria, Indonesia, and Ecuador"-countries that have crude for sale.

In recent years, Washington's foreign-policy machinery, under the tight direction of Henry Kissinger, has concentrated on building relations among the big powers-the Soviet Union, China, Japan, the allies in Western Europe. The result has been a slighting of the developing areas of the world, which hold the resources the U.S. will increasingly need. "Our policy institutions aren't adapted to these newly emerging economic realities," says Federal Reserve Chairman Burns.

Many experts believe the U.S. metals-dependence problem will be reflected in rising prices, rather than in a cutoff of supplies. "You wouldn't suddenly find yourself without copper, for example, but you could find the price so high you couldn't afford it," Mr. Zinner says.

Increasing world-wide demand for metals presents suppliers with an opportunity to raise prices, and the oil crisis demonstrates how quickly suppliers can move. Immediately after Iran auctioned crude oil for as much as $17.34 a barrel, Indonesia, Boliva, and Ecuador announced they intended to raise prices, too. "We can't close our eyes to the prices of oil in the last few months" declared Indonesia's minister of mining, Mohammad Sadli.

THE ALUMINUM OUTLOOK

Predicting how or where a metals crisis might erupt is difficult. John Morgan, acting director of the Bureau of Mines, says only that the U.S. could find itself in trouble in "any one" of the metals it imports heavily.

Right now, the aluminum situation appears particularly threatening. Among the danger signs: reports that the leading bauxite-producing countries plan to meet early next year to discuss establishment of a producer organization similar to the Organization of Petroleum Exporting Countries, or OPEC.

In addition to OPEC, which has shown its muscle in raising oil prices, there is the Inter-governmental Council of Copper Exporting Countries (Chile, Peru, Zambia and Zaire) and the International Tin Council (producing members are Malaysia, Bolivia, Indonesia, Nigeria, Zaire and Australia).

In the long run, some government experts predict; one critical supply problem may be in uranium. "The world resources that are known, assuming that we have access to them, just aren't adequate," an Interior Department analyst says.

U.S. RICH IN RESOURCES

Still, the situation isn't entirely bleak. For one thing, the U.S. remains rich in natural resources. In many instances, American industry has turned to foreign metal supplies because they have been cheaper than remaining domestic supplies.

For example, the U.S. has aluminum-bearing ore in Georgia and Alabama. But methods haven't yet been developed so these low-grade resources can be used economically. The U.S. also possesses much low-grade iron ore.

Some experts also question whether poor countries, lacking the unifying political cause of the Arabs, could actually get together to raise prices and control supplies. The major copper-exporting countries, says a Washington expert, "aren't geographically cohesive." However, such arguments are rejected by Brookings' Mr. Bergsten, who believes that joint action is more likely in some raw materials than it was in oil.

In any case, U.S. officials are talking about ways to conserve metals in the future as well as to increase U.S. production. Some officials also believe its time to take another look at the administration policy, established last spring in the hopes of lowering metal prices, of disposing of most of the government's huge strategic-materials stockpile.

"What the stockpile has provided," an Interior Department planner says, "is tremendous bargaining power for this country in the international sphere. With it, you don't let these bandits hold you up."

Office of Minerals Exploration
345 Middlefield Road
Menlo Park, California 94025

March 12, 1974

Northern Lights Exploration Co., Inc.
724 Cedar Street
Anchorage, Alaska 99501

Re: OME Application (Gold-Silver-Platinum-Antimony-Tin)
Northern Lights Exploration Co., Inc.
Shotgun Creek et al. Groups of Claims
Talkeetna Recording District, Alaska

Gentlemen:

Your application for exploration assistance dated March 8, 1974, has been received, and the original has been forwarded to our office in Washington, D.C., where a docket number will be assigned and the application reviewed. The duplicate copy is retained in this office.

We regret that all OME funds for the fiscal year ending June 30, 1974, are committed to contracts previously approved. The outlook for next fiscal year is not good--we have been told that funds for the OME program are not likely to be appropriated. We will hold your application in active status until official notice is received.

Our preliminary review of your application indicates that the costs of the proposed mapping, sampling, and geophysical work needed to define the targets and locate exact drill sites are not allowable in an OME contract. These preliminary jobs are considered to be prospecting; drilling to test a specific location where a concealed ore body is inferred is exploration, under the guidelines established for the OME.

Under these conditions, you may wish to proceed with the work at your own expense. If funds are made available to OME, it is doubtful that your application could be processed before the snow flies next fall.

Sincerely yours,

H. K. Stager
Field Officer
OME, Region II

cc: OME, Wash., D.C.
DRF
ACG RF
MP RF
Docket

RMSmith:mkh

UNITED STATES
DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY
Office of Minerals Exploration
345 Middlefield Road
Menlo Park, California 94025

March 12, 1974

OFFICIAL COPY
O. M. E.
RECEIVED
MAR 21 1974
P.m

INITIALS	CODE
	HK
	GW

Memorandum

To: Chief, Office of Minerals Exploration
Washington, D. C.

From: Field Officer
Region II

Subject: New Application (Gold-Silver-Platinum-Antimony-Tin)
Northern Lights Exploration Co., Inc.
Shotgun Creek et al. Groups of Claims
Talkeetna Recording District, Alaska

Enclosed is the original of a new application received March 11, 1974; a copy is retained in our file.

This application is for OME assistance in a $150,000 project in two general areas, Shotgun Creek (Area 1) and Horseshoe Ridge (Area 2), which are two of five groups totaling 650 unpatented contiguous lode(?) mining claims. The proposed project consists of geologic mapping, geochemical and geophysical surveys, and an unspecified amount of core drilling in unspecified locations to be determined by preliminary mapping, sampling, and geochemical and geophysical prospecting.

The proposal is based on two USGS publications, Circular 617 (1969) and Prof. Paper 758-A (1973) supplemented by atomic absorption analyses of 15 grab and specimen samples, 9 soil samples, 8 stream sediment samples, and 4 "mineral" samples collected by the applicant. One sample contained 2.4% copper, two others 1.34% and 1.14%, and the others 0.82% or less. Traces of nickel, zinc, arsenic, lead, gold, and silver were found in all samples.

The assay company recommends that the owner obtain aeromagnetic maps of the area from the State, conduct a ground magnetometer (or EM) survey, map the geology, sample the stream sediments, sample the entire claim area, and define potential drilling targets.

The State Assayer recommends that the fissure vein in Area 1 be sampled, and if this proves favorable, follow up with drill holes.

We conclude that the application is premature because the probability of a discovery by the exploratory drilling cannot be assessed until the preliminary prospecting is completed. The application could not be approved in its present form, even if OME had sufficient funds.

If the application is not approved, the documents are to be returned to the applicant.

R. M. Smith

for H. K. Stager

Enclosure

Northern Lights Exploration Co., Inc.

724 Cedar Street
Anchorage, Alaska 99501
(907) 272-7252

R. W. Voss
President
729 Ocean View Dr.
SRA Box 1450A
Anchorage, AK 99502
(907) 344-1492

C. Girard Davidson
Attorney-At-Law
Commonwealth Building
Portland, Ore. 97204
(503) 223-3800

March 8, 1974

Office of Minerals Exploration Field Office
Region II
Building 2
345 Middlefield Road
Menlo Park, California 94025

Dear Sir:

Enclosed please find MME Form 40, Application for Financial Assistance in Minerals Exploration, with supporting documents, attached separately, as follows:

1. Financial Eligibility - Appendix A.
2. Applicant's Rights in Land - Appendix B.
3. Physical Description of Property - Appendix C.
4. Accessibility of Property - Appendix D.
5. Exploration Work - Appendix E.
6. Experience - Appendix F.
7. Estimates of Costs - Appendix G.
8. Maps - back pocket folder.

Sincerely yours,

R. W. Voss
President

cc:
C. Girard Davidson
Attorney-At-Law
Commonwealth Building
Portland, Oregon 97204

Henry G. Bryant, Sec.Treas.
Northern Lights Exploration Co., Inc.
724 Cedar
Anchorage, Alaska 99501

RWV:coc

RECEIVED
MAR 11 1974
OFFICE OF MINERALS EXPLORATION
U.S. GEOLOGICAL SURVEY
MENLO PARK, CALIF.

MME Form 40
(Revised Nov. 71)

Form approved
Budget Bureau No. 42-R1368

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

APPLICATION FOR FINANCIAL ASSISTANCE IN MINERALS EXPLORATION

Pursuant to Public Law 85—701 (72 Stat. 700; 30 U.S.C. 641)

NAME OF APPLICANT *(Full legal name and mailing address as they should appear on contract if one is executed.)*

NORTHERN LIGHTS EXPLORATION CO., INC.
724 Cedar Street
Anchorage, Alaska 99501

APPLICANT DO NOT USE THIS BLOCK

DOCKET NUMBER: 6902

DATE RECEIVED: March 21, 1974

REGION: II

DIVISION CODE:

BUSINESS ORGANIZATION *(Check one)*

- INDIVIDUAL [ ]
- CORPORATION [X]
- PARTNERSHIP [ ]
- OTHER *(Specify)* [ ]

STATE IN WHICH FIRM IS ORGANIZED: Alaska

LIST CORPORATE OFFICERS OR PARTNERS HERE, IF APPLICABLE

NAME	ADDRESS	TITLE
Raymond W. Voss,	729 Ocean View Dr., Anchorage, Alaska 99502	President
Rudolph F. Chase,	332 Muldoon Road, Anchorage, Alaska	V-President
Henry G. Bryant,	724 Cedar Street, Anchorage, Alaska 99501	Sec.-Treas. Agent

MINERAL(S) FOR WHICH YOU WISH TO EXPLORE: Au, Ag, Pt, Sb, Sn

ESTIMATED COST OF PROJECT: $150,000.00

PROPERTY NAME	LOCATION COUNTY	STATE
NORTHERN LIGHTS EXP.CO.,INC.	Hurricane, (Healy A6)	Alaska

GENERAL INSTRUCTIONS

Before filling out this application, please read the *OME Regulations for Obtaining Federal Assistance in Financing Explorations for Mineral Reserves* (30 CFR Chap. II). To assure prompt action, your application must provide all applicable material and information specified on the back of this application form. Avoid unnecessary correspondence and delays by submitting complete and accurate information. *Please submit two copies of this application and all accompanying papers* except as otherwise noted. Place your name and address on each sheet. Each item of information, maps, and reports required as a part of this application is described on the back of this form. Identify each attached statement by the item number to which it applies. If an item does not apply to your application, show the item number on your statement and after it write "not applicable." Maps or sketches should be used to supplement narrative descriptions of the property location and boundaries in item 2, existing mine workings and geology in item 3, and the proposed exploration work in item 5. When this information is not too complex, all of it may be shown on one map or sketch. All documents and other attachments submitted as a part of this application, except those in item 3(g) which you mark to be returned, become the property of the Government and will not be returned to the applicant. Send true copies, *not originals*, of leases, contracts, and other documents which are an essential part of your business records. *File this application with the Department of the Interior, U.S. Geological Survey, Office of Minerals Exploration, Washington, D. C., 20242, or with the nearest OME Field Office.*

CERTIFICATION

The undersigned, whether as an individual, corporate officer, partner, or otherwise, both in his own behalf and acting for the applicant, certifies that the information set forth in this form and accompanying papers is correct and complete, to the best of his knowledge and belief, and that he would not ordinarily undertake the proposed exploration under current conditions and circumstances at his sole expense.

March 8, 1974
DATED

Raymond W. Voss
RAYMOND W. VOSS
BY *(Signature)*

President, NLEC
TITLE

A wilfully false statement or certification to any Department or Agency of the United States Government is a criminal offense.
U. S. Code, Title 18, Sec. 1001.

INFORMATION REQUIRED WITH THIS APPLICATION

(submit on accompanying pages)

1. Financial Eligibility:

(a) Submit evidence of efforts made within 90 days preceding the filing of this application to obtain credit from your bank of account and at least one other banking institution or other private source of credit. Such evidence shall include (1) *true copies of your letters to credit sources* which show date of loan request, amount and terms requested, and proposed use of loan funds and (2) *true copies of replies from credit sources.* If the loan was offered under terms which you consider unreasonable, state why you consider them so.

(b) List names and addresses of affiliated, parent, or controlling companies or organizations and state extent and nature of their interest.

(c) State how you propose to furnish your share of the cost of the exploration work.

2. Applicant's Rights in Land:

(a) State your interest in the land and mineral rights, whether owner, lessee, purchaser under contract, or other. If you are not the owner, submit one true copy of the lease, contract, or other document (with address of owner) under which you control the property. Describe all liens, mortgages, or other encumbrances on the land and state book and page number and official place where recorded.

(b) State the legal description (section, township, and range; metes and bounds; patent number of claims) of the land upon which you wish to explore and all adjacent land, which you own or control. Describe any part of the land or workings which should not be subject to Government royalty and liens. If the land consists of unpatented claims, state book and page number for each recorded location notice, including amended locations, and official place where recorded. State all the names by which you know the property.

(c) For all land or mineral rights encumbered or not owned, submit five copies of Lien and Subordination Agreements signed by owner on MME Form 52. If the agreements cannot be obtained, state reasons and whether you can furnish a performance bond.

3. Physical Description:

(a) Describe in detail and illustrate with maps or sketches all mining or exploration operations which you know have been or are being conducted upon the land. Include existing mine workings and all production facilities.

(b) State your interest, if any, in operations described in (a)

(c) State, if you know, the past and current production, supporting your statement with copies of settlement sheets, mine records, or published data if available.

(d) Describe known ore reserves, giving quantities and grades.

(e) Describe by narrative and maps or sketches the geologic features of the property, including ore minerals, geologic formations if known, and type of deposit (vein, bedded, etc.).

(f) If you have sampled the area you propose to explore, show where the samples were taken, describe sampling methods used, and provide copies of assay certificates. State your reasons for expecting to find ore.

(g) Send with your application at least *two* copies of all geologic or engineering reports, assay maps, or technologic information which you have, indicating whether you require their return.

4. Accessibility of Property:

(a) To aid the OME representative who may examine the property state name, address, and telephone number of person who will meet him; give directions for reaching the property; and describe accessibility of property and of any mine workings.

(b) Name the shipping and supply points and state the distances to the property.

5. Exploration Work:

(a) Describe fully the proposed exploration work giving individual footages and sizes of openings *for each item of work.* Use narrative, maps, plans, and sections as necessary. Show location of the proposed work as related to geologic features such as veins, ore-bearing beds, contacts of rock formations, etc. Show on maps also the relation of the proposed work to any existing mine workings and to *claim boundaries* or to the closest identifiable corner.

(b) If an access road must be built, show the proposed location on the property map and state the length, type and construction methods proposed.

(c) If an OME contract is executed, state how soon thereafter work would be started and finished. State your anticipated average daily or monthly rate of progress for each type of work.

6. Experience:

State your operating experience and background to conduct this exploration work and also that of the person who will supervise the work.

7. Estimate of Costs:

Furnish detailed estimates of the necessary costs for time and materials *for each item of the work proposed in 5(a)* under the headings listed below with a total for each heading and the estimated total cost of the work. Costs for any work to be performed by an independent contractor should be listed separately under category (a) below. Costs for any work that is not to be performed by an independent contractor should be listed under categories (b) through (g).

(a) Independent contracts. State the total cost of any proposed independent contract for all or any part of the work, and the number of units and the unit cost for each type of work, such as per foot of drilling, per foot of drifting, per hour of bulldozer operations, or per cubic yard of material moved. Cost estimates should be supported by bids from three contractors if possible. (*Note*—If none of the work is to be contracted, write "none" after this item.)

(b) Personal services. The cost of supervision, engineering and geological services, outside consultants, and labor should be itemized by numbers and classes of employees; rates of wages, salaries or fees and periods of employment. State whether these services are available.

(c) Operating materials and supplies. List items of material and supplies giving quantity and price of each. Include under this heading power, water, and fuel, and units of equipment and tools costing less than $50 each.

(d) Operating equipment. List items of equipment and tools costing $50 or more per unit. Give specifications and indicate how each item is to be acquired—i. e., rented, purchased or provided by the applicant. If rented or purchased, state the estimated rental or purchase price and mobilization charge. If furnished by the applicant, state condition and present fair market value.

(e) Initial rehabilitation and repairs. Describe the type and the cost of *initial* rehabilitation or repair of existing buildings, fixtures, installations (exclusive of mine workings), and movable operating equipment now owned by the applicant which will be used in the exploration work.

(f) New buildings, fixtures, installations. Describe each building, fixed improvement, and installation to be purchased, constructed, or installed for the exploration work, stating specifications and cost including labor, and materials.

(g) Miscellaneous. Describe the type and estimate the cost of repairs and maintenance of the operating equipment listed in 7(d). Do not repeat initial repairs listed in 7(e). Show also the costs of analytical work, accounting, workmen's compensation and employees' liability insurance, payroll taxes, and other required costs that do not fall within the previous categories. [*Note*—The Government will not contribute to costs incurred before the date of the contract, or to costs of or incident to: (1) acquiring, using, or possessing land and any existing improvements, facilities, buildings, installations, and appurtenances, or the depreciation and depletion thereof; (2) general overhead, corporate management, interest and taxes (other than payroll and sales taxes); (3) insurance (other than employees' liability insurance); and (4) damages to persons or property (other than authorized repairs to or replacement of equipment or other property used in the work

APPENDIX A

1. FINANCIAL ELIGIBILITY:

(A) SUBMIT EVIDENCE OF EFFORTS MADE WITH 90 DAYS PRECEDING THE FILING OF THIS APPLICATION TO OBTAIN CREDIT FROM YOUR BANK OF ACCOUNT AND AT LEAST ONE OTHER BANKING INSTITUTION OR OTHER PRIVATE SOURCE OF CREDIT. SUCH EVIDENCE SHALL INCLUDE (1) TRUE COPIES OF YOUR LETTERS TO CREDIT SOURCES WHICH SHOW DATE OF LOAN REQUEST, AMOUNT AND TERMS REQUESTED, AND PROPOSED USE OF LOAN FUNDS AND (2) TRUE COPIES OF REPLIES FROM CREDIT SOURCES. IF THE LOAN WAS OFFERED UNDER TERMS WHICH YOU CONSIDER UNREASONABLE, STATE WHY YOU CONSIDER THEM SO.

True copies of request for loan to credit sources attached hereto as Appendix A1. True copies of replies from credit sources attached hereto as Appendix A2.

(B) LIST NAMES AND ADDRESSES OF AFFILIATED, PARENT, OR CONTROLLING COMPANIES AND STATE EXTENT AND NATURE OF THEIR INTERESTS.

Applicant is parent company, as well as controlling company. Applicant has no affiliated companies.

(C) STATE HOW YOU PROPOSE TO FURNISH YOUR SHARE OF THE COST OF THE EXPLORATION WORK.

Share of Northern Lights Exploration Company, Inc. of proposed loan amounts to $37,500.00. Share will be expended as outlined in Appendix G, paragraph 7b and 7d. Northern Lights Exploration Company, Inc. expects to provide more than the $37,500.00 required, up to $45,000.00 to ensure unexpected or inflated prices, due to the pipe-line imput are met to complete proposed projected fully as outlined in Appendix C3 to a successful conclusion.

Northern Lights Exploration Co., Inc.

724 Cedar Street
Anchorage, Alaska 99501
(907) 272-7252

R. W. Voss
President
729 Ocean View Dr.
SRA Box 1450A
Anchorage, AK 99502
(907) 344-1492

C. Girard Davidson
Attorney-At-Law
Commonwealth Building
Portland, Ore. 97204
(503) 223-3800

February 28, 1974

Alaska National Bank
of the North
4th & E Streets
Anchorage, Alaska 99501

Dear Sir:

The Board of Directors of the Northern Lights Exploration Co. has taken action to seek financing of an exploratory core drilling program in the amount of one hundred fifty thousand dollars ($150,000). We ask your consideration of this loan.

We presently have 650 Federal claims staked and 90 State Prospecting Sites staked in the Healy (A-6 Quadrangle). All are registered in the Talkeetna Recording Office, Palmer, Alaska. The enclosed Chemical and Geological Laboratories of Alaska Inc. report indicates the extent of some of the potential of the area and costs out a program for exploration to prove the potential. In addition to the technical program there will be considerable cost for support and logistics in this area.

Your kind consideration will be appreciated.

Sincerely yours,

Henry Bryant

Henry Bryant, Sec-Treas.

Certified to be a true copy: R W Voss

R. W. Voss, President, NLEC

Subscribed and sworn to before me this 7th day of March 1974.

Drusilla Child

My Commission Expires
December 24, 1974

Appendix A1'

Northern Lights Exploration Co., Inc.

724 Cedar Street
Anchorage, Alaska 99501
(907) 272-7252

R. W. Voss
President
729 Ocean View Dr.
SRA Box 1450A
Anchorage, AK 99502
(907) 344-1492

C. Girard Davidson
Attorney-At-Law
Commonwealth Building
Portland, Ore. 97204
(503) 223-3800

February 28, 1974

National Bank of Alaska
Government Hill Branch
871 E. Loop Road
Anchorage, Alaska 99501

Dear Sir:

The Board of Directors of the Northern Lights Exploration Co. has taken action to seek financing of an exploratory core drilling program in the amount of one hundred fifty thousand dollars ($150,000). We ask your consideration of this loan.

We presently have 650 Federal claims staked and 90 State Prospecting Sites staked in the Healy (A-6 Quadrangle). All are registered in the Talkeetna Recording Office, Palmer, Alaska. The enclosed Chemical and Geological Laboratories of Alaska Inc. report indicates the extent of some of the potential of the area and costs out a program for exploration to prove the potential. In addition to the technical program there will be considerable cost for support and logistics in this area.

Your kind consideration will be appreciated.

Sincerely yours,

Henry Bryant

Henry Bryant, Sec-Treas.

Certified to be a true copy: R. W. Voss

R. W. Voss, President, NLEC

Subscribed and sworn to before me this 7th day of March, 1974.

Drusilla Childs

Appendix A1²

NATIONAL BANK OF ALASKA
Government Hill Branch • Box 600 • Anchorage, Alaska 99510

March 1, 1974

Northern Lights Exploration Co., Inc.
724 Cedar Street
Anchorage, Alaska 99501

Dear Sir:

We have reviewed your loan request for $150,000.00, but regret to inform you we will be unable to entertain such a request at this particular time. These funds were requested to be used in an exploratory program with no real assurance that there will be any income derived directly from such a program. Also, the Bank would be unable to secure the loan with sufficient collateral in that the Federal Claims & State Prospecting Sites staked in the Healy (A-6 Quadrangle) can not be taken as collateral. If I can be of any assistance to you in any other areas, please feel free to contact the undersigned.

Sincerely yours,

Dwain L. Skipworth

Dwain L. Skipworth
Assistant Cashier &
Manager, Gov't Hill Branch

Certified to be a true copy: R. W. Voss
R. W. Voss, President, NLEC

Subscribed and sworn to before me this 7th day of March, 1974.

Drusilla Childs

My Commission Expires
December 24, 1974

Appendix A2'

alaska national bank of the north

METROPOLITAN OFFICE: POUCH NO. 7-010 ANCHORAGE, ALASKA 99510 (907) 277-5511

February 28, 1974

Northern Lights Exploration Co., Inc.
724 Cedard Street
Anchorage, Alaska 99501

ATTENTION: Henry Bryant
Secretary/Treasurer

Dear Mr. Bryant:

After a careful review and analysis of your recent credit request, our finance committee finds it necessary to decline your loan request in the amount of $150,000.00, which was to be used for the purposes of exploratory core drilling in the Healy area.

We certainly appreciate your consideration in approaching our office in regard to your credit needs, and hope that we can be of service to you sometime in the near future.

Sincerely,

James H. Reaves

James H. Reaves
Vice-President & Manager

JHR/bew

Certified to be a true copy: R. W. Voss
R. W. Voss, President, NLEC

Subscribed and sworn to before me this 7th day of March, 1974.

Drusiela Childs

My Commission Expires
December 24, 1974

Appendix A2²

APPENDIX B

2. APPLICANTS' RIGHTS IN LAND:

a. OWNER: Northern Lights Exploration Company, Inc., 724 Cedar Street, Anchorage, Alaska 99501.

b. LEGAL DESCRIPTION:

(1) Section: 11 and 12 West.

(2) Township: Healy (A-6 Quadrangle).

(3) Range: 21.

(4) Property not included as exploration:

Partin Creek Claims, State of Alaska Prospecting Sites 1 through 90, listed and recorded in Book 52, pages 474 and 476, Talkeetna Recording District, Palmer, Alaska.

(5) Federal Unpatented Claims:

LUCKY BLUE CLAIMS 1 through 100	-	Recorded in Book 52, pages 499 through 598, Talkeetna Recording Office, Palmer, Alaska.
LITTLE REDBED CLAIMS 1 through 8	-	Recorded in Book 52, pages 599 through 606, Talkeetna Recording Office, Palmer, Alaska.
LUCKY GREEN CLAIMS 1 through 103 and 104 through 200	-	Recorded in Book 52, page 475, Talkeetna Recording Office, Palmer, Alaska.
SHOTGUN CREEK CLAIMS 1 through 175	-	Recorded in Book 52, page 477, Talkeetna Recording Office, Palmer, Alaska.
LITTLE SHOTGUN CREEK CLAIMS 1 through 167	-	Recorded in Book 52, pages 307 through 473, Talkeetna Recording Office, Palmer, Alaska.

(6) Claims listed in (5) above are also known as Northern Lights Exploration Co., Inc.

c. Claims listed in (5) above are not encumbered.

APPENDIX C

PHYSICAL DESCRIPTION:

3A. DESCRIBE IN DETAIL AND ILLUSTRATE WITH MAPS OR SKETCHES ALL MINING OR EXPLORATION OPERATIONS WHICH YOU KNOW HAVE BEEN OR ARE BEING CONDUCTED ON THE LAND. INCLUDE EXISTING MINE WORKINGS AND ALL PRODUCTION FACILITIES.

See Appendix C1, C2, and C3. (Preliminary Report of NLEC; State of Alaska Assayer's Report; Chemical and Geological Laboratories Report. See Appendix C4, C5 and map flap pocket.

B. STATE YOUR INTEREST, IF ANY, IN OPERATIONS DESCRIBED IN (A) ABOVE.

See Appendix C1, C2, and C3.

C. STATE, IF YOU KNOW, THE PAST AND CURRENT PRODUCTION, SUPPORTING YOUR STATEMENT WITH COPIES OF SETTLEMENT SHEETS, MINE RECORDS, OR PUBLISHED DATA IF AVAILABLE.

There are no existing mine workings or production data known to Northern Lights Exploration Co., Inc. Government reports covering the area and region are attached as Appendix C4 and C5.

D. DESCRIBE KNOWN ORE RESERVES, GIVING QUANTITIES AND GRADES.

Unknown at this time. Further exploration required to ascertain above desired data. Opinion of Northern Lights Exploration Co., Inc. stated in Appendix C1, with supportive data in Appendix C2 through C5.

E. DESCRIBE BY NARRATIVE AND MAPS OR SKETCHES THE GEOLOGIC FEATURES OF THE PROPERTY, INCLUDING ORE MINERALS, GEOLOGIC FORMATIONS IF KNOWN, AND TYPE OF DEPOSIT (VEIN, BEDDED, ETC.).

See Appendix C1 through C5.

F. IF YOU HAVE SAMPLED THE AREA YOU PROPOSE TO EXPLORE, SHOW WHERE THE SAMPLES WERE TAKEN, DESCRIBE SAMPLING METHODS USED, AND PROVIDE COPIES OF ASSAY CERTIFICATES. STATE YOUR REASON FOR FINDING ORE.

See Appendix C1 through C3. See Appendix C4 and C5 for governmental published supportive data and opinions. See back-flap of Appendix folder for detailed sampling encoded on map (legend to map coding on pages 13 and 14 of Appendix C1. Overlays to enlarged map by C&CL, Appendix C3.

G. SEND WITH YOUR APPLICATION AT LEAST TWO COPIES OF ALL GEOLOGIC OR ENGINEERING REPORTS, ASSAY MAPS, OR TECHNOLOGICAL INFORMATION WHICH YOU HAVE, INDICATING WHETHER YOU REQUIRE THEIR RETURN.

Above information included as Appendix C1 through C5. If assistance is granted, documents may be retained for files, otherwise, request documents be returned.

APPENDIX D

4. ACCESSIBILITY OF PROPERTY:

A. TO AID THE OME REPRESENTATIVE WHO MAY EXAMINE THE PROPERTY, STATE NAME, ADDRESS, AND TELEPHONE NUMBER OF PERSON WHO WILL MEET HIM; GIVE DIRECTIONS FOR REACHING THE PROPERTY; AND DESCRIBE ACCESSIBILITY OF PROPERTY AND OF ANY MINE WORKINGS.

Persons who would meet the OME representative for above information:

(1) Raymond W. Voss
729 Ocean View Drive
SRA Box 1450-A
Anchorage, AK 99502
Home: (902)344-1492
Off: (902)752-0248
(902)753-6253

(2) Henry G. Bryant
724 Cedar Street
Anchorage, AK 99501
Home: (902)272-7252
Off: (902)753-9165

(3) Jon Utpadel
819 Delaney Street
Anchorage, AK 99501
Home: (902)272-0091
Off: (902)752-0150

(4) Rudolph F. Chase
332 Muldoon Road
Anchorage, AK
Home: 333-5811
Off: 753-4165

B. NAME THE SHIPPING AND SUPPLY POINTS AND STATE THE DISTANCE TO THE PROPERTY.

Shipping and Supply Points: Hurricane RR Station, Alaska via Anchorage, Alaska. Hurricane Railroad Station is approximately eleven miles due east of property. Supplies may be shipped via truck or the Alaska Railroad from Anchorage, Alaska, a distance of approximately 130 miles.

APPENDIX E

5. EXPLORATION WORK:

A. DESCRIBE FULLY THE PROPOSED EXPLORATION WORK GIVING INDIVIDUAL FOOTAGES AND SIZES OF OPENINGS FOR EACH ITEM OF WORK. USE NARRATIVE, MAPS, PLANS, AND SECTIONS AS NECESSARY. SHOW LOCATION OF THE PROPOSED WORK AS RELATED TO GEOLOGIC FEATURES SUCH AS VEINS, ORE-BEARING BEDS, CONTACTS OF ROCK FORMATIONS, ETC. SHOW ON MAPS ALSO THE RELATION OF THE PROPOSED WORK TO ANY EXISTING MINE WORKINGS AND TO CLAIMS BOUNDARIES OR TO THE CLOSEST IDENTIFIABLE CORNER.

See Appendix C1, C2, C3, Appendix flap-cover for maps.

B. IF AN ACCESS ROAD MUST BE BUILT, SHOW THE PROPOSED LOCATION ON THE PROPERTY MAP AND STATE THE LENGTH, TYPE AND CONSTRUCTION METHODS PROPOSED.

For the purpose of this application, an access road to the property from the Hurricane area is not a consideration. The primary purpose of this application is to continue exploratory work already completed and follow recommendations of the State of Alaska Assayer and the Chemical and Geological Laboratories contained in Appendix C2 and C3. Exploratory work proposed for the summer of 1974 will entail identification of target areas; drilling program; and blocking out ore reserves.

An ice-road utilizing a "cat-train" can be utilized satisfactorily during winter months. Due to the proximity of the Alaska Railroad Station at Hurricane, eleven miles east of the property, a tram-gravity system for transporting ore/concentrates directly to the rail-line appears to be the most satisfactory method. An access road at some future date would be a consideration.

C. IF AN OME CONTRACT IS EXECUTED, STATE HOW SOON THEREAFTER WORK WOULD BE STARTED AND FINISHED. STATE YOUR ANTICIPATED DAILY OR MONTHLY RATE OF PROGRESS FOR EACH TYPE OF WORK.

Exploratory work outlined in Appendix C2 and C3 would be started in early June 1974 with completion date of 1 September 1974. Field work should be completed with 45 days from start. Remainder of time schedule will be finalized report for possible construction and ore production using blocked out ore reserve figures.

APPENDIX F

6. EXPERIENCE:

STATE YOUR OPERATING EXPERIENCE AND BACKGROUND TO CONDUCT THIS EXPLORATION WORK AND ALSO THAT OF THE PERSON WHO WILL SUPERVISE THE WORK.

All professional work for exploration as outlined in Appendix C3 would be contracted to the Chemical and Geological Laboratories of Alaska, Inc., Anchorage, Alaska.

APPENDIX G

7. ESTIMATE OF COSTS:

FURNISH DETAILED ESTIMATES OF THE NECESSARY COSTS FOR TIME AND MATERIALS FOR EACH ITEM OF THE WORK PROPOSED IN 5(A) UNDER THE HEADINGS LISTED BELOW WITH A TOTAL FOR EACH HEADING AND THE ESTIMATED TOTAL COST OF THE WORK. COSTS FOR ANY WORK TO BE PERFORMED BY AN INDEPENDENT CONTRACTOR SHOULD BE LISTED SEPARATELY UNDER CATEGORY (A) BELOW. COSTS FOR ANY WORK THAT IS NOT TO BE PERFORMED BY AN INDEPENDENT CONTRACTOR SHOULD BE LISTED UNDER CATEGORIES (B) THROUGH (G)

A. INDEPENDENT CONTRACTS: STATE THE TOTAL OF ANY PROPOSED INDEPENDENT CONTRACT FOR ALL OR ANY PART OF THE WORK, AND THE NUMBER OF UNITS AND THE UNIT COST FOR EACH TYPE OF WORK, SUCH AS PER FOOT OF DRILLING, PER FOOT OF DRIFTING, PER HOUR OF BULLDOZER OPERATIONS, OR PER CUBIC YARD OF MATERIAL MOVED. COST ESTIMATES SHOULD BE SUPPORTED BY BIDS FROM THREE CONTRACTORS IF POSSIBLE. (NOTE- IF NONE OF THE WORK IS TO BE CONTRACTED, WRITE "NONE" AFTER THIS ITEM).

All field and laboratory work directly connected with the drilling/exploration program will be contracted. Appendix C3 outlines total program and cost factors for core drilling program, etc. Due to the Alaska pipe-line project, only one local company considered capable and willing to undertake project and contract.

B. PERSONAL SERVICES: THE COST OF SUPERVISION, ENGINEERING AND GEOLOGICAL SERVICES, OUTSIDE CONSULTANTS, AND LABOR SHOULD BE ITEMIZED BY NUMBER AND CLASSES OF EMPLOYEES, RATES OF WAGES, SALARIES OR FEES, AND PERIODS OF EMPLOYMENT. STATE WHETHER THESE SERVICES ARE AVAILABLE.

The supervision, engineering and geological services, outside consultants and labor will be contracted by Northern Lights Exploration Co., Inc. This will be in support of program outlined in Appendix C3. Support will consist of: General Manager, Civil Engineer, Survey Crew, Accountant and labor force to supply logistics. Approximate cost for above support is estimated to be $45,000.00. With Alaska pipe-line labor expectations, no realistic figures can be made at this time, as it is expected that labor force prices will vary considerably.

C. OPERATING MATERIALS AND SUPPLIES: LIST ITEMS OF MATERIAL AND SUPPLIES GIVING QUANTITY AND PRICE OF EACH. INCLUDE UNDER THIS HEADING POWER, WATER, AND FUEL, AND UNITS OF EQUIPMENT AND TOOLS COSTING LESS THAN $50 EACH.

As this is a remote off the road site, a main base camp will be required at Hurricane, Alaska to provide food and lodging facilities for exploration/labor personnel. This will be contracted to Universal Services, Anchorage,

Alaska, who specialize in this type of service. Lodging facilities will be tents as will mess facilities. Absolute costs can not be estimated at this time due to the pipe-line activities.

D. OPERATING EQUIPMENT: LIST ITEMS OF EQUIPMENT AND TOOLS COSTING $50 OR MORE PER UNIT. GIVE SPECIFICATIONS AND INDICATE HOW EACH ITEM IS TO BE ACQUIRED - I.E., RENTED, PURCHASED, STATE THE ESTIMATED RENTAL OR PURCHASE PRICE AND MOBILIZATION CHARGE. IF FURNISHED BY THE APPLICANT STATE CONDITION AND PRESENT FAIR MARKET VALUE.

See Appendix C3 for contractual service materials.

In addition to those items listed in Appendix C3, the following will be supplied on rental basis by Northern Lights Exploration Co., Inc. These items are included in the estimated $45,000.00 expenditure by Northern Lights Exploration Co., Inc.

M50 Proton Magnetometer. Fair market value with charger $4,300.00. Unit to be used in overall exploration program for ground-grid surveying. Mfr: VARIANT.

Two-place Bentley helicopter to be utilized as "ferry-scout" from main base camp to site camp. Aircraft and insurace estimated to be $12,000.00. Use estimated at 45 days @ $95.00 per hr., minimum 3 hrs per day: $12,825.00. Price includes work services of operator in field over 3 hr. minimum time.

5 pick-up trucks and 4 self-contained campers will be utilized by Northern Lights Exploration Co., Inc., personnel. These are privately owned equipment and will be rented by NLEC at a nominal price to protect owners fair-wear-tear and liability. Estimated cost to NLEC for a 45 day period: $5,000.00.

XRF Analyzer, manufactured by INAX Instruments Ltd., Ottawa, Canada for site analysis, capable of automatically handling suites of up to 30 samples at a time, giving routine multi-element analytical results printed out at the rate of one sample every 1 to 3 minutes. Cost of unit $16,000.00. Rental: $390.00 per month plus transportation costs. Estimated rental costs: $1,500.00. Unit to be used in field at site-camp.

Total estimated costs to NLEC for above items: $23,625.00 This estimate part of total estimated costs noted in item b above of $45,000.00.

APPENDIX G - CONTINUED

E. INITIAL REHABILITATION AND REPAIRS: DESCRIBE THE TYPE AND THE COST OF INITIAL REHABILITATION OR REPAIR OF EXISTING BUILDINGS, FIXTURES, INSTALLATIONS (EXCLUSIVE OF MINE WORKINGS), AND MOVABLE OPERATING EQUIPMENT NOW OWNED BY THE APPLICANT WHICH WILL BE USED IN THE EXPLORATION WORK.

There are no cost factors involved in initial rehabilitation or repair of existing buildings, fixtures, installations, as none exist. Movable operating equipment now owned by the applicant which will be used in the exploration work has been explained under item d above.

F. NEW BUILDINGS, FIXTURES, INSTALLATIONS: DESCRIBE EACH BUILDING, FIXED IMPROVEMENT, AND INSTALLATION TO BE PURCHASED, CONSTRUCTED, OR INSTALLED FOR THE EXPLORATION WORK, STATING SPECIFICATIONS AND COSTS, INCLUDING LABOR AND MATERIALS.

None. Applied for assistance will be utilized only for exploration, drilling, etc., as outlined in Appendix C3.

G. MISCELLANEOUS: DESCRIBE THE TYPE AND ESTIMATE THE COST OF REPAIRS AND MAINTENANCE OF OPERATING EQUIPMENT LISTED IN 7D. DO NOT REPEAT INITIAL REPAIRS LISTED IN 7E. SHOW ALSO THE COSTS OF ANALYTICAL WORK, ACCOUNTING, WORKMAN'S COMPENSATION AND EMPLOYEES' LIABILITY INSURANCE, PAYROLL TAXES, AND OTHER REQUIRED COSTS THAT DO NOT FALL WITHIN PREVIOUS CATEGORIES. (NOTE-THE GOVERNMENT WILL NOT CONTRIBUTE TO COSTS INCURRED BEFORE THE DATE OF THE CONTRACT, OR TO COSTS OF OR INCIDENT TO: (1) ACQUIRING, USING, OR POSSESSING LAND AND ANY EXISTING IMPROVEMENTS, FACILITIES, BUILDINGS, INSTALLATIONS, AND APPURTENANCES, OR THE DEPRECIATION AND DEPLETION THEREOF; (2) GENERAL OVERHEAD, CORPORATE MANAGEMENT, INTEREST AND TAXES (OTHER THAN PAYROLL AND SALES TAXES); (3) INSURANCE (OTHER THAN EMPLOYEES'); AND (4) DAMAGES TO PERSONS OR PROPERTY (OTHER THAN AUTHORIZED REPAIR TO OR REPLACEMENT OF EQUIPMENT OR OTHER PROPERTY USED IN THE WORK).

None. All work and services will be contracted to those previously described in this Appendix (G).

Geology and Mineral Deposits of the Chulitna-Yentna Mineral Belt, Alaska

GEOLOGICAL SURVEY PROFESSIONAL PAPER 758-A

Geology and Mineral Deposits of the Chulitna-Yentna Mineral Belt, Alaska

By C. C. HAWLEY *and* ALLEN L. CLARK

GEOLOGY AND MINERAL DEPOSITS OF THE UPPER CHULITNA AND YENTNA DISTRICTS, SOUTH-CENTRAL ALASKA

GEOLOGICAL SURVEY PROFESSIONAL PAPER 758-A

A mineral belt along the southern flank of the west-central Alaska Range is defined on the basis of epigenetic mineral deposits and anomalous concentrations of metals in stream sediments

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1973

UNITED STATES DEPARTMENT OF THE INTERIOR

ROGERS C. B. MORTON, *Secretary*

GEOLOGICAL SURVEY

V. E. McKelvey, *Director*

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GEOLOGY AND MINERAL DEPOSITS OF THE CHULITNA-YENTNA MINERAL BELT, ALASKA

By C. C. HAWLEY and ALLEN L. CLARK

ABSTRACT

The Chulitna-Yentna mineral belt, which extends northeastward for 100 miles or more along the southern flank of the west-central Alaska Range, is nearly parallel to the strike of sedimentary and volcanic rock units, to the direction of elongation of intrusive bodies, and to major faults or lineaments. The Chulitna-Yentna belt is defined principally on the basis of an alinement of epigenetic mineral deposits [and] subordinately on anomalous concentrations of metals in the sediments of the streams that drain the belt. Arsenic and gold are the metals most characteristic of the entire belt; copper, tin, and other metals occur locally. The belt shares tectonic or compositional features comparable with some well-known mineral belts of the western Cordillera, including the Juneau gold belt.

INTRODUCTION

The Chulitna-Yentna mineral belt, on the southeastern flank of the west-central Alaska Range, is defined herein, principally on the basis of epigenetic mineral deposits that have a nearly linear arrangement. It is parallel to and is nearly coincident with a zone of northeastward-striking faults subparallel to the local trend of the Alaska Range and the major Chulitna Valley lineament.

This report serves as a general summary and introduction to two others—one on the northern part of the belt, or Upper Chulitna district (Hawley and Clark, 1973), and the other on the Yentna district (Clark and Hawley, 1968). The three are part of a general assessment of a larger region, the southern central Alaska Range and northern Talkeetna Mountains, undertaken in 1967 and 1968.

LOCATION

The Chulitna-Yentna mineral belt is centered about 130 miles north of Anchorage on the southeast flank of the west-central Alaska Range (fig. 1). It is a nearly linear feature 5–20 miles wide and at least 100 miles long in relatively low, but locally rugged, mountainous terrain between the main valley of the Susitna and Chulitna Rivers and the summit peaks of the Alaska Range. The southern part of the belt near Petersville is accessible by road from near Talkeetna, and the entire belt is within 6–50 miles of The Alaska Railroad.

The belt includes large parts of three districts or regions defined in other reports—Yentna, Curry, and Upper Chulitna (fig. 1). The Yentna district, defined by Capps (1913), extends approximately from a few miles south of Collinsville to the Tokositna River; the Curry district, from the Tokositna River to Eldridge Glacier (Tuck, 1934); the Upper Chulitna district, from Eldridge Glacier to near the Bull River (Hawley and Clark, 1973). Neither the Curry district (which includes the Tokosha Mountains) nor the southern part of the upper Chulitna district, both generally rugged and inaccessible, have been studied or prospected extensively.

PREVIOUS AND PRESENT INVESTIGATIONS

Although the Chulitna-Yentna mineral belt has not heretofore been recognized as a geologic entity, most of it has been studied in reconnaissance. Most investigations of the metallic resources along the belt were made before 1935. Capps was the first geologist of the U.S. Geological Survey to visit the Yentna district (Capps, 1912, 1913) and the Upper Chulitna district (Capps, 1919); he later revisited the Yentna district (Capps, 1925) and made three summaries of the geology and mineral resources on the Alaska Railroad belt (Capps, 1924, 1933, and 1940). Mertie (1919) studied the placer deposits of the Yentna district and described the occurrence of platinum, cassiterite, and other minerals

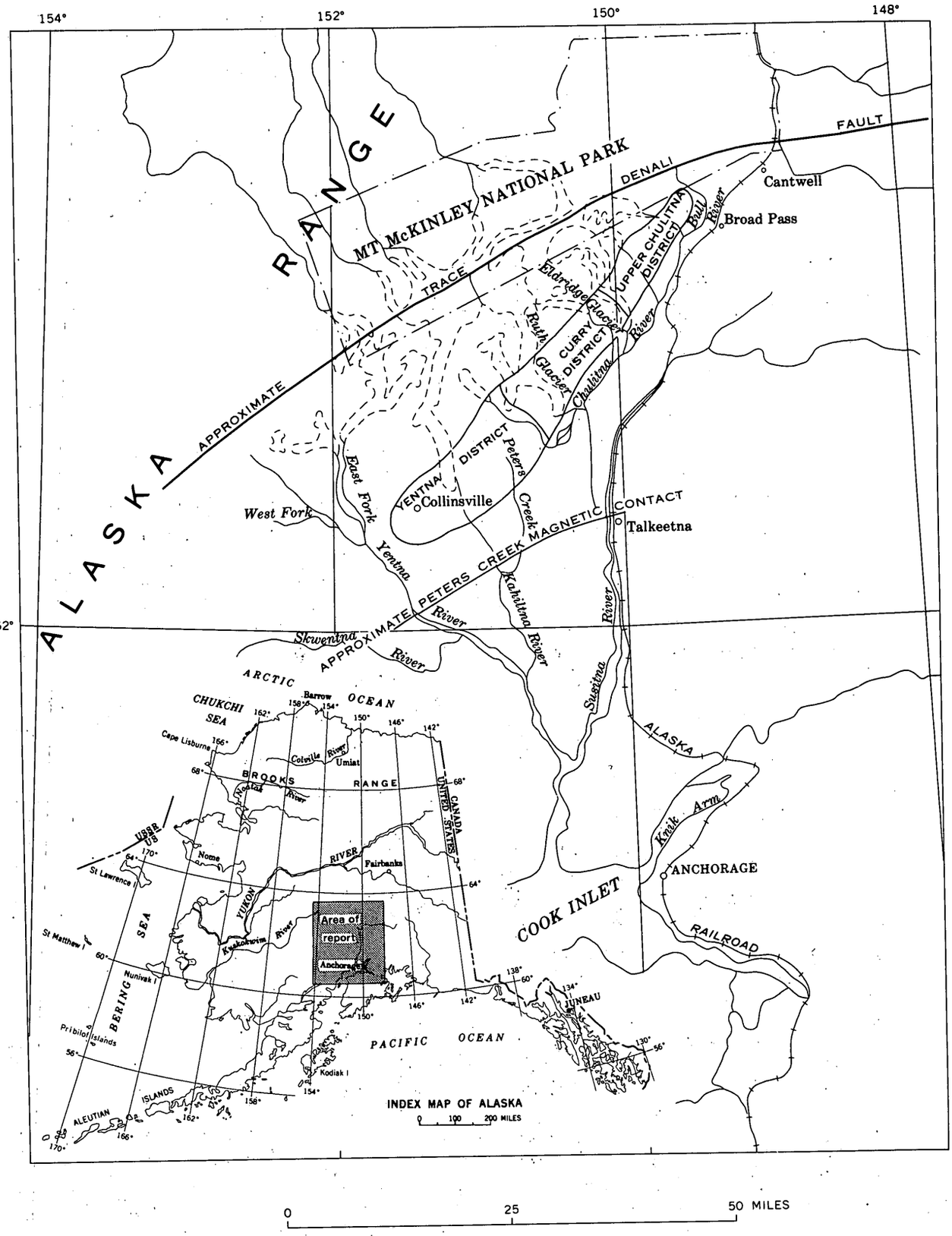

FIGURE 1.—Index map showing location of the Chulitna-Yentna mineral belt.

in the placer concentrates. The Upper Chulitna district was reexamined and mapped in 1931 by Ross (1933); Ralph Tuck followed developments near the Alaska Railroad belt for several years and made a reconnaissance of most of the Curry district (Tuck, 1934).

Except for studies of radioactivity in placer deposits of the Yentna district (Robinson and others, 1955), the Geological Survey's investigations of metallic resources along the belt began in 1967 and continued in 1968. Reports on these investigations by the authors and associates are listed in "References cited."

Our investigation was mainly reconnaissance except for detailed mapping of small areas near mineralized rocks. The approximate detail of investigations in the part of the area north of Eldridge Glacier averaged about 1:63,360; investigations in the Yentna district corresponded to about 1:125,000 scale coverage, and those in the central part or Curry district to about 1:250,000. Samples of stream sediments have not been collected in parts of the Curry district, but the coverage elsewhere corresponds to the mapping scales (Hawley and others, 1969; Clark and Hawley, 1968).

GEOLOGIC SETTING

The Chulitna-Yentna mineral belt is defined principally on the basis of epigenetic metallic deposits. Secondary criteria that authenticate the belt are placer deposits derived from lodes within the belt and anomalous concentrations of metals in stream sediments. Localities of all known lodes and placer deposits of the belt are plotted on a generalized geologic map (pl. 1). Stream-sediment samples that contain anomalous concentrations of metals are shown if they are in drainages away from known deposits, as they could indicate the existence of undiscovered bodies of mineralized rock.

The mineral belt has an average trend of about N. 45° E. and extends from a few miles south of Collinsville (fig. 1) to near the Bull River. Possible northeast and southwest extensions of the belt are masked by widespread surficial deposits, but an alinement of placer gold occurrences that projects toward lode occurrences near the Skwentna River (Spurr, 1900) suggests that the belt may continue about 35 miles farther southwest. To the north, the belt makes an acute angle with the Denali fault; to the south, it makes and acute angle with, and possibly joins, the major structural break marked by the Peters Creek magnetic contact of the Mount Susitna magnetic anomaly group (Grantz and others, 1963).

The epigenetic metallic deposits along the belt are of approximately the same age and are primarily veins or combined vein-disseminated deposits. They have a distinctive trace-element suite of metals that includes arsenic, gold, copper, tin, antimony, and bismuth.

The Chulitna-Yentna mineral belt is subparallel to both structural and lithologic trends along the south flank of the west-central Alaska Range; as shown in detail, it transects progessively younger rocks southward. Sedimentary and volcanic rocks underlie most of the belt, but a major batholith cuts across its central part, and small masses of hypabyssal rocks cut both its northern and southern extremities.

STRATIGRAPHY

Sedimentary and volcanic rocks of the mineral belt range in age from Paleozoic to Tertiary but are predominantly Mesozoic. They can be diveded by lithology and age into three main groups (pl. 1). The oldest group, exposed mainly north of Eldridge Glacier on the southeast side of the belt, consists of nonfossiliferous siliceous argillite, graywacke, and shaly or slaty argillite. Unconformably overlying this group are lithologically varied mafic volcanic rocks, red beds, limestones, and calcareous argillites of Permian and Triassic age. The red beds consist of a sequence of hematitic sandstone, siltstone, conglomerate, and breccia. Clasts in the coarser grained units are chiefly quartz, red chert, and argillite, and mafic and intermediate volcanic rocks; locally, the matrix of the conglomerate breccia is tuffaceous; this, together with the presence of anomalous concentrations of chromium and nickel in the unit, suggests general mafic volcanism near the time of sedimentation. Fossiliferous limestones and pillow lavas are intercalated throughout the Permian and Triassic section and are diagnostic of at least local marine conditions. Conformably overlying the Permian and Triassic group is a group of generally noncalcareous dark argillite, graywacke, and conglomerate of Jurassic(?), Cretaceous, and possibly Paleocene age.

The pre-Permian rocks have undergone low-grade metamorphism, as indicated by the presence of chlorite and secondary biotite. Permian through Paleocene (?) rocks are essentially unmetamorphosed except in the Curry district, where rocks equivalent at least of pre-Permian, Permian, and Triassic rocks of the Upper Chulitna district have been moderately to highly metamorphosed. Specifically, equivalents of red strata are purple to green phyllite; mafic volcanic rocks are green schist; limy units are calcareous schist with intercalated marble; and argillaceous units are dark phyllite to andalusite schist in the Curry district.

Coal-bearing and locally auriferous detrital sedimentary rocks of Oligocene and Miocene age locally overlie, with marked angular unconformity, rocks of Paleozoic, Mesozoic, and possibly Paleocene age. Coal-bearing rocks occur near Costello Creek, lower Coal Creek, and Ruth Glacier, and in the Yentna district as shown by Barnes (1966); they are, however, younger

than hypogene mineral deposits of the belt, and in figure 2 are combined with locally extensive glacial and fluviatile deposits of Quaternary age.

IGNEOUS ROCKS

Igneous rocks of the belt range in composition from ultramafic through diorite and quartz diorite to granite. Except for the batholith of the Curry district, the intrusive rocks form stocks, plugs, and dikes, many of which are too small to show at 1:500,000 (the scale of fig. Z).

Ultramafic rocks, largely converted to serpentinite, and associated gabbro and basalt are abundant north of Eldridge Glacier and scarce to the south. They generally form masses that are elongate parallel to the northeast structural grain and the mineral belt. Two small serpentinite bodies were reported by Ralph Tuck (unpub. data, 1932) south of Eldridge Glacier, and the existence of ultramafic or mafic rocks elsewhere along the southern part of the mineral belt is suspected because chromite and some platinum are found in placer concentrates.

Quartz diorite and diorite, generally porphyritic, occur in the part of the belt north of Eldridge Glacier. They form dikes that strike mostly northeastward and stocks of mappable size, particularly near the West Fork of the Chulitna River. Quartz monzonite or granite forms dikes and small stocks at several localities along the belt and in the batholith that transects the belt. The rocks of the batholith are mainly medium- to coarse-grained biotite granite or quartz monzonite; rocks in the smaller plutons are mainly fine to medium grained and light colored, and locally contain muscovite and tourmaline as characteristic accessory minerals.

Small syngenetic deposits of chromite are found in the ultramafic rocks, and many epigenetic metal deposits of the belt show a close spatial relation to the rocks of intermediate to granitic composition. Rich gold-arsenopyrite veins of the Yentna district are in ladder and strike veins in felsic dikes, and the Golden Zone and several other deposits of the Upper Chulitna district are in quartz diorite, diorite, or quartz (granitic) porphyry host rocks. Granitic rocks of the belt locally have detectable amounts of tin, about 10 ppm (parts per million) or more, and a tin-bearing greisen in upper Ohio Creek is in a muscovite-tourmaline-albite granite.

Both the epigenetic metallic deposits and most of the igneous rocks were emplaced after folding and faulting of the Permian, Mesozoic, and Paleocene(?) rocks but before deposition of coal-bearing rock of Oligocene and Miocene age.

STRUCTURE

The northeasterly trend of the belt is established by the parallelism of lithologic units, the fold axes, and the major high-angle faults and lineaments, these features are probably the main control of the mineral belt. Only a few of the numerous faults and lineaments appear to persist through long distances parallel to the strike of the belt. These structures include (1) the upper Chulitna fault, (2) the West District fault, (3) the Peters Hills lineament, and (4) the Pass Creek fault and Dutch Creek lineament (pl. 1).

UPPER CHULITNA FAULT

The Upper Chulitna fault is a complex structure that can be traced from near Hidden Creek south of Eldridge Glacier to the Costello Creek coal basin, where it is buried by Oligocene sedimentary rocks. The fault is poorly exposed between Hidden Creek and Eldridge Glacier. However, a definite lineament striking N. 40° E. can be projected through prominent saddles and broken zones and, in small tributaries to Swift Creek, through a zone of limonitic spring deposits. North of Eldridge Glacier, the fault consists of two or more subparallel strands or branches. At least one strand of the fault contains elongate masses of serpentinite or gabbro and basalt from the glacier to Long Creek, and small bodies of serpentinite or gabbro are on a branch of the fault north of the West Fork of the Chulitna River. North from a point near Copeland Creek, one prominent strand of the fault splits into two branches: the west branch trends northward into the Blind Creek fault (pl. 1; Ross, 1933); the east branch crosses the West Fork of the Chulitna near Lookout Mountain and can be traced northeastward to the Costello Creek coal basin, where it is buried by Oligocene rocks.

WEST DISTRICT FAULT

Another major fault on the northern part of the belt can be traced from Eldridge Glacier nearly to the West Fork of the Chulitna River; this structure is 1½ to 3 miles northwest of the Upper Chulitna fault zone. Near Partin Creek the fault separates basalt and limestone from red beds; northward it crosses into the dark argillite-graywacke series. Most mineral occurrences of the Canyon Creek–Partin Creek area (Nos. 10–13) lie west of the fault (pl. 1).

PETERS HILLS LINEAMENT

The northwest edge of the Peters Hills forms a nearly straight line trending N. 42° E. that coincides with a fault postulated by Capps (1913, fig. 6) to control the observed distribution of Tertiary sedimentary rocks in the basin between the Peters and Dutch Hills. Most of the productive placers of the Cache Creek basin are confined to the area northwest of the fault.

PASS CREEK FAULT AND DUTCH CREEK LINEAMENT

The Pass Creek fault (Barnes, 1966, pl. 1), near the

northwest edge of the Collinsville part of the Yentna district, projects toward the prominent Dutch Creek lineament. This lineament forms the northwest edge of the Dutch Hills along the valleys of Dutch and Bear Creeks.

RELATION OF MINERAL BELT TO MAJOR FAULT STRUCTURES

The relation of the mineral belt to structures like the Upper Chulitna fault is significant. Relationships such as this have been demonstrated elsewhere by Tweto and Sims (1963), Roberts (1966), and Jerome and Cook (1967). The Upper Chulitna fault is a deep crustal structure, as implied by its length and shown by its control of igneous bodies, particularly the mafic and ultramafic ones. North of Eldridge Glacier, serpentinite, basalt, and gabbro are well exposed in linear bodies in and near the Upper Chulitna fault (pl. 2). These bodies contain local concentrations of chromium minerals and local epigenetic deposits of copper, gold, and other metals. They are therefore of direct economic importance to the belt as well as of geologic importance as depth indicators.

Other features that may be deep structures are the poorly exposed Pass Creek fault and its projection, the Dutch Creek lineament. Serpentinite and mafic rocks are sparsely exposed south of Eldridge Glacier, but occurrences of chromite and platinum in placer deposits and anomalous concentrations of chromium in stream sediments suggest their presence below the extensive surficial deposits. The distribution of chromium in stream sediments (pl. 2) in the southern part of the belt is consistent with derivation from primary deposits in and near the Pass Creek fault–Dutch Creek lineament.

MINERAL DEPOSITS

Mineral deposits and occurrences in the Chulitna-Yentna mineral belt include a few small syngenetic deposits of chromite and rocks with anomalous concentrations of nickel in ultramafic hosts, numerous epigenetic bodies containing arsenic, gold, copper, tin and other metals, and placer deposits of gold. The epigenetic deposits that are the principal basis for definition of the belt include metallized rocks in veins, lodes, shear zones, disseminated deposits, and one deposit in a breccia pipe.

The deposits, like those of many mineral belts, appear to be in clusters along the trend of the belt; part of the clustered appearance may reflect lack of data and limited prospecting. One main group of deposits (Nos. 1–9, pl. 1) is in a linear zone about 10 miles long, at the northern part of the belt. This zone extends from south of Long Creek to north of the West Fork of the Chulitna River and includes the Golden Zone deposit. Another cluster is in upper Ohio Creek (Nos. 10–12, pl. 1). Occurrences southwest of Nos. 10–11 and anomalous concentrations of metals in streams heading into the interlayered limestone and basalt unit (pl. 1) suggest that deposits may be scattered through at least an 11-mile-long zone from Eldridge Glacier to upper Ohio Creek that coincides with the interlayered rock unit.

A third cluster of deposits is in the main part of the Yentna district, near the Dutch Hills. The productive deposits here have been placer gold deposits with by-product platinum and locally abundant cassiterite. Because these deposits are secondary, the validity of a hypogene mineral belt crossing the district is dependent on the existence of lode deposits of gold, tin, and other metals within the belt. Both Capps (1913) and Mertie (1919) proposed that the source of much of the placer gold was near, and Mertie (1919, p. 257–260, p. 261–262) stated specifically that gold and cassiterite in Poorman, Willow, Long, and Canyon Creeks were largely derived from visibly mineralized rocks of their drainage areas. Prospecting done since the visits of Mertie and Capps has resulted in the discovery of additional lode sources. Small but very rich veins are now known in Nugget and Bird Creeks and on the ridge between them (Nos. 16–18, pl. 1). In addition, auriferous quartz-conglomerate-braccia zones of the Yentna district that were described as placer deposits by Mertie (1919, p. 249–251, 252) and Capps (1925, p. 55–56) are now regarded as hypogene deposits that locally have been reworked into conglomerates (Clark and Hawley, 1968).

Although a source of cassiterite has not been identified, anomalous concentrations of tin are found in some veins and igneous rocks of the Yentna district. Another placer mineral of the district, scheelite, has been found with free gold and arsenopyrite in veins near Bird Creek.

No lode occurrences have been found in the cluster of placer deposits near Collinsville. Older bedrock is in fault contact with Tertiary rocks in the vicinity of Pass Creek (pl. 1), and the pattern of gold distribution suggests that the lode sources could be in or near the Pass Creek fault structure. However, the placer deposits may have been formed by reworking of Tertiary sedimentary rocks that contain small amounts of gold.

Very few deposits or occurrences are known in the part of the belt between Ruth and Eldridge Glaciers (pl. 1), but this area has not been extensively prospected. Stream-sediment samples that were collected in the area near the Upper Chulitna fault between Eldridge Glacier and the Hidden River contained anomalous concentrations of metals in several samples; these concentrations suggest that more metallic deposits exist than were previously reported.

A possible southward projection of the belt (not

shown on pl. 1) between Collinsville and the Skwentna River is largely covered by Quaternary deposits. Though there is only one known outcrop of lode minerals (Freeman, 1963, p. 29–30), gold occurs in shallow placer deposits along the Nakoshna, Kichatna, and Skwentna Rivers (Capps, 1913, p. 70–71; Spurr, 1900, p. 260–261) very near the projected strike of the belt. South of the Skwentna where Mesozoic rocks are again exposed, slightly auriferous pyrite, chalcopyrite, and galena veins were reported by Spurr (1900, p. 110–112, 259–263). The data, though inconclusive, are consistent with a projection of the mineral belt southwestward for approximately 35 miles.

MINERALOGY AND METAL CONTENT

Individual deposits of the belt are generally characterized by a few dominant minerals and metals, but the complete suite is a complex one. The principal minerals are arsenopyrite, pyrite, pyrrhotite, and chalcopyrite; the minor minerals include common metallic minerals such as galena, bismuthinite, cassiterite, scheelite, and stibnite. The minor minerals, as shown in table 1, are known from only a few occurrences, but assays show that their metals are widely dispersed along the belt.

TABLE 1.—*Ore minerals of the Chulitna-Yentna mineral belt*

[A, major mineral of several deposits; M, moderate abundance in several deposits; Sp, sparse, may be locally abundant; O, only one occurrence known; W, widespread; Y, Yentna only; Ch, Chulitna only; X, present]

	Abundance	Distribution	Placer	Lode
Native elements:				
Gold	M	W	X	X
Copper	Sp	Y	X	.....
Platinum[1]	Sp	Y	X	.....
Sulfides and sulfosalts:				
Arsenopyrite	A	W	X	X
Pyrite	A	W	X	X
Pyrrhotite	M	Ch	.....	X
Chalcopyrite	M	Ch	.....	X
Sphalerite	M	Ch	.....	X
Galena	M	Ch	.....	X
Do	Sp	Y	X	.....
Stibnite	Sp	Ch	.....	X
Do	O	Y	X	.....
Molybdenite	O	Ch	.....	X
Bismuthinite	O	Ch	X	.....
Argentite	O	Ch	.....	X
Chalcocite	O	Ch	.....	X
Tennantite(?)	O	Ch	.....	X
Oxides:				
Magnetite	M	Y	X	.....
Ilmenite	M	Y	X	.....
Do	Sp	Ch	.....	X
Chromite	M	Y	X	.....
Do	O	Ch	.....	X
Cassiterite	M	Y	X	.....
Do	Sp	Ch	.....	X
Wodginite (Ta, Nb, Sn, Fe, Mn) O_2	O	Ch	.....	X
Rutile(?)	Sp	Y	X	.....
Uranothorianite	Sp	Y	X	.....
Tungstates:				
Scheelite	Sp	Y	X	X
Phosphates:				
Monazite	M	Y	X	.....

[1]Mertie (1919) described two varieties of platinum metals in the Yentna placers; one a dark-gray or bronze type in flaky grains of <1 mm size; the other a bright silver type in more crystalline grains.

DISTRIBUTION AND OCCURRENCE OF GOLD, ARSENIC, COPPER, TIN, AND SOME OTHER METALS

Arsenic and gold appear to characterize nearly the entire belt, as shown by their abundance and pattern of distribution in lode deposits, placer deposits, and stream sediments. Copper is particularly characteristic of the part of the belt north of Eldridge Glacier, tin of the part of the belt north of Ohio Creek and of the main Yentna district.

Gold.—Gold is widely distributed along the Chulitna-Yentna belt in lode deposits, in stream sediments and is abundant in placer deposits of the Yentna district (pl. 2). Lode deposits or occurrences in the Upper Chulitna district, described by Ross (1933), and Capps (1919), and Hawley and Clark, (1973), include the Golden Zone and nearby prospects and the Partin Creek occurrence. Gold-bearing lodes in the Yentna district, which have not been as well described, include small and locally very rich deposits associated with felsic dikes and apparently low-grade deposits in major shear and altered zones. The highest grade deposits recognized are at the Bird Creek prospect, the Colby and nearby prospects, and a mineralized dike swarm in Nugget Creek. Assays exceeding 1 ounce of gold per ton have been obtained from all three areas, and selected quartz-arsenopyrite vein material from one of the Colby prospects assayed about 200 ounces of gold per ton. Two gold-bearing veins from the Curry district (pl. 2) and rich gold-bearing float from Whistler Creek have been reported by Tuck (1934).

Placer deposits of gold are abundant in the Yentna district and have been prospected in Shotgun and Bryn Mawr Creeks in the Upper Chulitna district. In the Yentna district, most of the streams draining the south flank of the Dutch Hills have auriferous deposits, as do the tributaries of Twin and Mills Creeks near Collinsville (pl. 2). Placer gold is locally present on the north flank of the Dutch Hills, and there is one important mine southeast of the Peters Hills. Gold in stream-sediment samples along the east flank of the northern Peters Hills suggests that other deposits might be developed north of the Peters Creek placer deposit.

The abundance of gold in the belt is pointed up by the frequency of its occurrence in stream-sediment samples as compared with its general absence in areas east and west of the belt. Gold was found in concentrations of 0.02 ppm or more in 21 percent of approximately 160 stream-sediment samples of the Upper Chulitna district; it was found in 17 percent of about 130 samples from the main part of the Yentna district, and in 50 percent of 8 stream-sediment samples from the Curry district part. In the Yentna district in particular, these amounts are known to be minimal, because

gold placer areas were avoided in sampling. In contrast, gold was found in only 7 percent of 157 samples from the northern Talkeetna Mountains east of the Chulitna valley, and in only 1.5 percent of about 1,100 samples from the Southern Alaska Range about 80–100 miles west-southwest of the Yentna district (Reed and Elliott, 1968; Elliott and Reed, 1968).

Although the median gold content of the stream-sediment samples from the belt cannot be calculated or read directly, it can be estimated statistically or graphically (Shoemaker and others, 1959). Projections on a frequency distribution diagram (Hawley and Clark, 1973) suggest that the median concentration of gold in streams from the Upper Chulitna part of the belt would probably lie within the range of 0.001 to 0.005 ppm. Such concentrations are characteristic of streams draining weakly mineralized regions according to Fischer and Fisher (1968, p. 2, table 2). An unmineralized area investigated by the same authors had an approximate gold content of 0.000X–0.0000X ppm and an auriferous area of 0.006–0.3 ppm, the latter range is very similar to concentrations found near known deposits in the Chulitna-Yentna belt.

These comparisons were not made quantitatively. Concentrations of gold in streams of the Chulitna-Yentna belt were estimated from atomic absorption analysis of stream sediment samples, whereas Fischer and Fisher (1968) calculated gold concentration in stream sediments from analyzed preconcentrated samples. The estimates, however, are believed to be qualitatively significant, especially when used with other evidence of the enrichment of gold in the belt.

Arsenic.—Arsenic, mainly in arsenopyrite, is present in most lode deposits of the belt and locally is the most abundant metal. In was detected in approximately 18 percent of the stream-sediment samples of the Chulitna district, although its detection limit is about 200 times its crustal abundance. Although detected in only about 3 percent of stream-sediment samples of the Yentna district, arsenopyrite was found in placer concentrates from many creeks (Robinson and others, 1955; Mertie, 1919) and in the small lode deposits of the district, as shown on plate 2. Plate 2 also shows the location of some arsenopyrite lode deposits where gold is not abundant or where there is no assay information on gold.

The abundance of arsenic in the belt, like gold, is best shown by a comparison with nearby regions. The southern Alaska Range area investigated by Reed and Elliott (1968; Elliott and Reed, 1968) is well mineralized and is characterized by high median concentrations of zinc, lead, and silver in stream sediments draining the area. Arsenic, however, was detected in only one of more than 500 samples that were collected in 1967 and analyzed in the same way as samples from the Chulitna-Yentna belt. In the northern Talkeetna Mountains, arsenic was detected in less than 1 percent of a group of 157 samples that were also analyzed by the same method.

Copper.—Copper minerals are found in many lode deposits in the northern part of the belt, native copper in placer concentrates in the southern part. And copper is present in anomalous amounts in stream sediments, particularly in the part of the belt north of the Hidden River. The median concentration of copper in stream-sediment samples from the Upper Chulitna district is approximately 70 ppm. This concentration is about twice the median of a group of 40 samples of unmineralized bedrock from the district and is higher than concentrations in most common rock types except basalt (Turekian and Wedepohl, 1961).

The map of copper distribution (pl. 2) shows two groups of lode occurrences; those where copper locally exceeds more than 5,000 ppm (0.5 percent) and those where it locally exceeds 1,000 ppm.

Tin.—Tin, a diagnostic element of the mineral belt, though not found as widely as gold or as abundantly as arsenic, copper, and zinc, occurs in greisen at one place on Ohio Creek, in arsenopyrite-bearing veins at Canyon Creek and Long Creek, and in much greater than normal abundance in several other deposits such as the Golden Zone and some granitic rocks of the belt. Cassiterite, a common and locally major constituent of the Yentna placers, may be very close to its primary source. This conclusion is suggested by the sharp crystalline outlines of the cassiterite grains found in concentrates from Poorman and Canyon Creeks (Mertie, 1919). Data on tin are summarized on plate 2 in three main categories: lode deposits; placer deposits, including stream-sediment anomalies; and intrusive rocks. As the tin content of most granite is only about 3 ppm or less (Turekian and Wedepohl, 1961), concentrations exceeding 15 ppm are considered to be anomalous. Rattigan (1963), Varsukov and Pavlenko (1956), and Sainsbury (1964) have pointed out that granites with associated tin deposits generally contain approximately 15 ppm or more tin. Tin is shown on plate 2 as a major element in lode deposits if its concentration exceeds 1,000 ppm, as a minor element if its concentration locally exceeds 500 ppm, and as detected if it locally exceeds 50 ppm.

Other metals.—Deposits of the belt are commonly enriched in antimony, bismuth, and silver, and locally in other metals, including cadmium, lead, tungsten, and zinc. Analyses of arsenic-rich veins of the Upper Chulitna district (Hawley and Clark, 1973, table 4) show that antimony, bismuth, and silver are ubiquitous components of such veins, and that antimony and bismuth are locally abundant enough to form discrete

minerals. These same elements and tin are found, but generally in much lower concentration, in some disseminated deposits of the Upper Chulitna district (Hawley and Clark, 1973, table 5). Data on vein composition are much scarcer for in the Yentna district, but both antimony and bismuth are found in the arsenopyrite-quartz veins at the Rocky Cummins and Bird Creek prospects, along with gold, tin, and tungsten.

COMPARISON WITH SOME OTHER MINERAL BELTS

The Chulitna-Yentna mineral belt is similar to some well-known mineral belts in linearity and length, general relation to faults and igneous intrusives, tectonic position relative to the western Cordillera, and metal content.

Belts like the Front Range mineral belt (Colorado), the Idaho-Montana porphyry belt, and the Battle Mountain–Eureka belt (Jerome and Cook, 1967) are, like the Chulitna-Yentna belt, strongly linear and approximately 100 miles or more long. These belts contain clusters of igneous rocks, clusters of ore deposits, and intervening sparsely mineralized areas; they are localized essentially by fault structures that apparently extend deep into the crust.

The Chulitna-Yentna belt compares with two other well-known mineral belts — the Juneau gold belt (Spencer, 1906) and the Mother Lode belt (Knopf, 1929)—by its tectonic position on the flank of a mountain system. All the belts are on the ocean flank of a mountain system; the Chulitna-Yentna belt, in the Cordilleran Mountain system, is on the flank facing the Pacific Ocean. These belts have similar associations of igneous rocks, although serpentinite is apparently lacking in the Juneau gold belt. Rock types common to all three belts are gabbro, diorite, quartz diorite, and sodic granite or other late sodic differentiates. The metal suites are similar but do not correspond exactly. For example, arsenopyrite is the main metallic mineral of the Chulitna-Yentna belt, secondary after pyrite in the Mother Lode, and an important local constituent in the Juneau gold belt ores.

The Chulitna-Yentna belt contrasts with the Juneau gold and Mother Lode belts by being characterized by an association of rocks that are generally not metamorphosed, and by having a relatively greater abundance of metallic minerals contained in vein deposits as compared with quartz. Except for some poorly metallized quartz veins like those of the Blind Creek fault zone (Hawley and Clark, 1973, fig. 2), quartz veins are not characteristic of the Upper Chulitna district. Quartz veins are, however, abundant in parts of the Curry district (Tuck, 1934); they are believed to be abundant in the Yentna district where they are represented by the generally poorly exposed zones of crushed quartz and alteration minerals (Clark and Hawley, 1968).

The metal suite of the Chulitna-Yentna belt is strikingly similar to that of the Battle Mountain–Eureka mineral belt of Nevada (Roberts, 1966; Jerome and Cook, 1967). As shown by Wrucke, Armbrustmacher, and Hessin (1968) and by Erickson, Van Sickle, Nakagawa, McCarthy, and Leong (1966), gold deposits along the Nevada belt are characterized by arsenic, antimony, bismuth, cadmium, copper, mercury, lead, silver, tin, and tungsten. Arsenic is, perhaps, the most characteristic associate of gold (C. T. Wrucke, oral commun., 1969). These metals, with the possible exception of mercury, whose abundance is not known, are also characteristic of the Chulitna-Yentna mineral belt.

MINERAL RESOURCES AND GENERAL SUGGESTIONS FOR PROSPECTING

The value of the Chulitna-Yentna belt as a metal resource, based on geologic mapping and reconnaissance sampling, some drilling information, and past production, is at least several tens of millions of dollars. Geologically, the belt has potential for (1) vein and disseminated deposits in the belt of limestone and basalt, which contain occurrences at Partin and Canyon Creeks in the southern part of the Upper Chulitna district, (2) replacement deposits in volcanic units or limestones, (3) shear-zone deposits, and (4) breccia pipes in the northern part of the belt near the Golden Zone. Rocks favorable for replacement deposits, such as limestones and greenschists, are also present in the Curry district in the central part of the belt. Although the granite batholith that cuts across the belt in the Curry district generally is not favorable for prospecting, an enrichment of copper and molybdenum in widespread limonitic knots in the granite suggests that the metals could be enriched in certain environments such as the contact regions and cupolas. Anomalous concentrations of metals found in stream sediments collected in the Curry district between the Hidden River and Eldridge Glacier suggest that mineral deposits are more widely distributed in the central part of the belt than previously believed. In the Yentna district, the variety of placer deposits, together with the difficulty of finding bench or buried channel-type deposits in extensively alluviated terrain, suggests that undiscovered deposits exist in the area. A favorable locale for prospecting, as indicated by the gold content of stream-sediment samples, is along the northeast flank of the Peters Hills. Some of the small vein deposits of the Yentna district are locally rich enough in gold and tungsten to be exploited profitably if mined on a small scale.

The Chulitna-Yentna belt has produced gold valued

at more than $7 million (at $35 per ounce) from the placer deposits of the Yentna district and more than $60,000 from lode deposits in the Upper Chulitna district. Although the highly productive Cache Creek basin of the Yentna district has been mined extensively, there are unmined bench and buried-channel deposits near Cache Creek and in lower Cache Creek. One deposit near Bird Creek has drilled reserves of more than $1 million; very likely there are other deposits whose approximate reserves are known by owners, but this information is not available. Because of the possibility of undiscovered placers along the east side of the Peters Hills and the multiple types and ages of placers, it is not unreasonable to assume that as much gold remains in the Yentna district as has been mined.

In the Upper Chulitna district, calculable resources are much greater than the known production. Fairly abundant assay data on the Golden Zone show that it is worth more than $10 million (Hawley and Clark, 1968). Ross (1933) and Thurmond (unpub. data, 1918) estimated reserves of about 10,000 tons and within the range $50,000 to about $200,000 on vein deposits of the Eagle and Ready Cash, respectively; and data from surface samples at other veins such as the East, and Little, and one vein at Partin Creek permit estimates of about the same order. Mining rocks with disseminated sulfides like those at Partin Creek and Canyon Creek along with the veins possibly is feasible and could lead to a manyfold increase in apparent estimated tonnage of the vein-type deposits.

The belt is believed to have some potential for the production of metallic commodities other than gold and silver. Tin is abundant enough in some vein deposits that it might be recovered as a byproduct; and other greisen deposits where tin is the principal commodity of value could be present in and near the Ohio Creek tin-bearing granite. Antimony, bismuth, and tungsten are locally abundant enough to be of economic interest.

The belt has some potential for deposits of chromium or nickel in and near ultramafic rocks, and the presence of ultramafic rocks in a belt with other intrusive rocks is geologically favorable for the formation of asbestos deposits in the serpentine.

Because of the relative scarcity of geologic data on the belt, the conclusions on mineral resources are speculative, but the dollar estimate given of metals as a resource is almost certainly of or below the right order of magnitude. It is uncertain how much of the metallic resource of the belt could be exploited at the present time. The authors believe that the belt is worth diligent prospecting and exploration.

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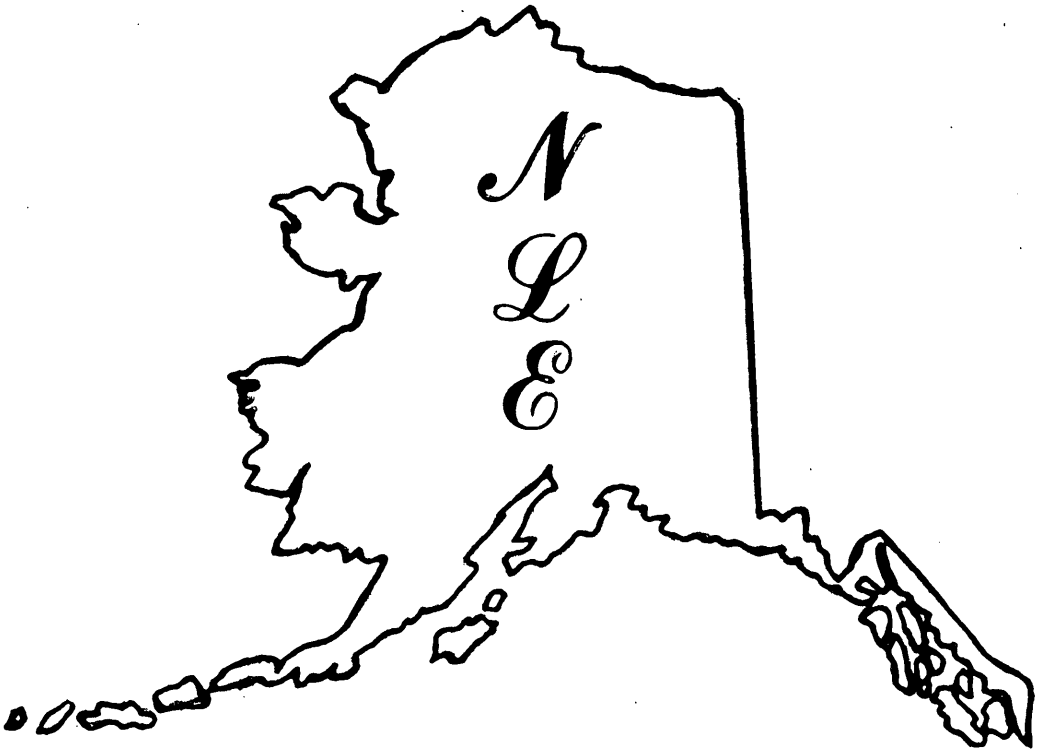
A PRELIMINARY MINERAL REPORT

of an Area Northwest of the Chulitna River, Central Alaska Range



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APPENDIX

Geological Survey Circular 617 ---------- A

Geological Survey Professional Paper 758-A ---------- B

State Assayer's Report and other assays ---------- C

Chemical & Geological Laboratories of Alaska, Inc. Report ---------- D

ADDITIONAL

Enlarged (magnification 4) of section of Healy A-6 Quadrangle Map, covering property in jacket of back flap. Scale: 4"=1 Mile.

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8 January 1974

PRELIMINARY REPORT

The following information is submitted, with supporting documents, regarding an Area Northwest of the Chulitna River, Central Alaska Range which may be of interest to your company as a high potential area for future mineral production.

GENERAL INFORMATION

The general area was investigated by the U.S. Geological Survey in 1967 and by Hawley and Clark in 1968. The findings were published in 1969 as *GEOLOGICAL SURVEY CIRCULAR 617*, entitled "RESULTS OF GEOLOGICAL and GEOCHEMICAL INVESTIGATIONS in an AREA NORTHWEST OF THE CHULITNA RIVER, CENTRAL ALASKA RANGE". (See Appendix A).

The area was again investigated by Hawley and Clark in 1973, and along with previously gathered data, summarized their findings in *GEOLOGICAL SURVEY PROFESSIONAL PAPER 758-A*. (See Appendix B).

An aeromagnetic survey is reportedly to have been conducted on the area by the State of Alaska. Public maps were to have been on sale by January 1974. To date this information has not been verified officially.

Hawley and Clark defined the CHULITNA-YENTNA Belt principally on the basis of an alignment of epigenetic mineral deposits. Gold and arsenic appeared to be the metals most characteristic of the entire belt (which extends northeastward for more than one

hundred miles along the southern flank of the west-Central Alaska Range.

Copper, tin and other metals occur locally. According to Hawley and Clark, the belt shares tectonic or compositional features comparable with some well-known mineral belts of the Western Cordillera, including the Juneau Gold Belt.

The quartz monzonite batholith, exposed for a considerable distance (between Ruth and Eldridge Glaciers) is noteworthy of attention (see map pocket of Professional Paper 758-A (Appendix B).

The entire area covered by reports (Appendix A and B) lie within six to fifty miles of the Alaska Railroad and the new Anchorage-Fairbanks all-weather highway.

AREA LOCATION

Approximate coordinates of Shotgun Creek area: 149°55'W-63°04'N (Healy A-6 Quadrangle Map). The property lies approximately eleven miles west of the Alaska Railroad Hurricane Station (the Station being about 1/2 miles from the new Anchorage-Fairbanks all-weather highway). Rail or road transportation should pose no problem. The property is located approximately 130 miles north of Anchorage, where deep-water facilities are available. With the Beluga Electric-Power Project (approximately 50 miles south of the property), under study for development, power to the area should be readily available.

BASIC EXPLORATION DATA

Considering the reports by Hawley and Clark, examination of the area, and referencing sample reports, copper, gold, silver, nickel and other base metals, appear to be very worth considerations.

The property held by Northern Lights Exploration Company appears to have high copper ore in a number of locations. Out of eight samples from NLEC property sent to the State of Alaska Assayer, six indicated copper percentages from .7% to 3.4%. Two of these six also gave a good showing of silver (.58 and .6 oz/ton). (See Appendix C for report of State Assayer and other assaying reports).

Preliminary findings of the Chemical & Geological Laboratories of Alaska, Inc., Anchorage, Alaska (Appendix D), support the findings of the State Assayer (Appendix C). All sampling information (including ground and stream sediments) have been transferred to an enlarged map of the Healy A-6 Quadrangle Map. This map is affixed to the rear flap of this report. It is the concenus that the metals were brought in by hydrothermal activity. As the basalt-gabbro appears to be one of the host materials (especially for copper), it is interesting to note that areas of gabbro-basalt apparently follow well-defined fault lines (and there appears to be complex and cross-faulting in and near these areas). This can be observed by the geological referencing on the enlarged map section.

While antimony was not pursued in any detail in the Hawley-Clark reports, they did find the metal in various stream sediments. Of interest, are two streams, converging from glaciers (just north of NLEC property) and emptying into McCallie Creek. Antimony was noted at the junction of the two streams and again where they emptied into McCallie Creek. No samples were noted between the head of McCallie Creek and at the point mid-way, where antimony was noted. Some close attention to this particular area of NLEC property should be closely observed for the

possibility of the mineral stibnite.

According to Hawley and Clark it would appear that the epigenetic metallic deposits along the belt are of approximately the same age and are primarily veins or combined vein-disseminated deposits. The possibilities of segregated (or pod) sulfide bodies of copper, silver, etc., underlying the general area, appears very feasible. One ore specimen (C&GL #1346-1) was noted as assaying 39.5% iron and 0.57% copper, along with minor amounts of silver, gold, and lead.

While a few small syngenetic deposits of chromite and rocks with anomalous concentrates of nickel in ultramafic hosts were noted, Hawley and Clark stressed the numerous epigenetic bodies containing arsenic, gold, copper, tin, and other in place metals, as well as placer deposits of gold.

It is these epigenetic deposits that are the principal basis for defining the belt and include metallized rocks in veins, lodes, shear zones, disseminated deposits, and one deposit in a breccia pipe.

EXPLORATION OF THE SHOTGUN CREEK AREA

A fissure type vein was observed and sampled in this area, about a mile from the headwaters of Shotgun Creek.

The vein is about 12+ feet in width at the base with a talus slope about four hundred feet above the stream bed. It extends vertically about five hundred feet, branching out at its top into a massive weathered outcrop some 400 x 400 feet and has a composition composed of chalcopyrite and heavily stained by the carbonates azurite and malachite. Native copper was also observed in

the samples taken. As native copper has been noted in numerous samples, the comment by VANDERS and KERR in "MINERAL RECOGNITION" (Wiley & Sons, 1967), appears appropriate: "*Small amounts of copper (native) are commonly associated with cuprite, malachite, and azurite in the oxidized zones above copper sulfide deposits.*" This statement is particularly noteworthy, inasmuch as the primary mineral appears to be chalcopyrite and the end alteration of this mineral is native copper.

Since heavy sulfides have been found along and below the fissure-vein (one assaying 3.4% copper), it would appear that the area in front of the fissure and the one on the opposite side (north) would be favorable to a deep-seated sulfide body. It does not appear to be unreasonable to suspect that the fissure-vein itself may be the direct result of such an underlying deposit. Samples taken along the top and both flanks of this particular area for a distance of approximately 3 miles (east-west) with a width of about 3,000 feet, were found to carry chalcopyrite. Considering the large area containing this mineral, the possibility of finding a large deep-seated sulfide body is strengthened. The State Assayer comments that the materials appear to be hydrothermal deposition. Basalt porphory was noted at location N3, carrying chalcopyrite, malachite, native copper and tenorite. N6 was noted as basalt, as was N7. All three showed good percentages of copper.

The deposits like those of many mineral belts appear to be in clusters along the trend of the belt. It was noted that upon standing at the top of the fissure-vein, looking about 1 mile to the NE, lies "Horseshoe Ridge". Samples taken from this area,

assayed up to 2.4% copper. Directly over the fissure-vein ridge (toward a small unnamed stream), abundant samples of copper ore were obtained from large outcrops. Samples from this area assayed 1.45% copper (N2 State Report). At the base of this sampling area, a direct line drawn in a southerly direction, would intersect the fissure-vein. The distance between the sides, at a conservative estimate, would be about three thousand feet.

Looking toward the southwest (from the top of the fissure-vein), about 5-1/2 miles, is another copper outcrop (with gold veinlets (some which assayed out at 2.44 oz/ton). These cited outcrops lie in a direct southwest-northeast direction for well over four miles, and are within well defined fault zones (which may have enriched the general area).

Hawley and Clark suggest that deposits may be scattered throughout at least an eleven mile-long zone, from Eldridge Glacier to Upper Ohio Creek (see Appendix A and B).

MINERAL POTENTIAL

Although Hawley and Clark in their reports stress gold and arsenic, assays indicate good possibilities of large copper deposits. Stream sediments indicate antimony, especially in the streams draining from the Lucky Green Property into the McCallie Creek region. Two good silver assay reports were also noted.

Stream sediments also indicate chromium and nickel, both within the NLEC property boundaries, and also in stream samples taken from creeks leaving the property.

It is fairly apparent that copper may be of commerical quality and quantity to produce the metal economically. This factor can be given more consideration when considering the

property location in relationship to the Alaska Railroad, the new Anchorage-Fairbanks all-weather highway, and the proposed Beluga Power Project (discussed under Area Location).

EXPLORATION CONSIDERATION AREAS

As was pointed out by the State Assayer and C&GL of Alaska, Inc., in their reports, it would appear that a "target(s)" area be selected with good surface sampling programs, followed up with several shallow and a few deep drill holes. (See Appendix C and D).

It has further been suggested, that upon availability of the State aeromagnetic maps, an initial EM program be initiated to substantiate findings of aeromagnetic information. This type of surveying and correlation work has been conducted with great success in NorthernSweden, Canada, etc. Reference: *MINING GEOPHYSICS by D.S. Paranis* (Elsevier Publishing Co., NY, 1966).

Considering the above tentative recommendations, two areas have been selected for consideration.

AREA I: This area lies approximately 3/4 miles from the edge of the glacier at the head of Shotgun Creek. It is in this area that the large, heavily stained (copper) fissure-vein, previously commented upon, was observed and sampled. (See Appendix C and D). This area is bordered by a faulted zone. Large pieces (cobbles to boulders) of arsenopyrite litter the stream floor from the front of the glacier area to just west of the fissure-vein. This material was found to contain gold and other metals. It was apparent that these materials were from slides and broken ledges, and had not moved any great distance. Arsenopyrite was also found in place 1,000 feet above the stream bed

between the fissure-vein area and the glacier. Heavy sulfides were found in place just below the glacier. Breccia was noted in quantity in talus areas, but sampling of this material was random and showed no great mineral content from what was assayed. The breccia may warrant further study.

AREA II: Approximately one mile northeast of Area I. Sampling on one large outcrop ("Horseshoe Ridge") revealed copper as high as 2.4% in weathered material identified as chalcopyrite in quartzite and the State Assayer reported (N7)(Lab. #41646) copper as 1.58%, the material being identified as basalt with chalcopyrite, malachite, and pyrite.

A number of other samples taken from the area were heavily stained with malachite and azurite. These samples were taken randomly from "Horseshoe Ridge", traversing the ridges around the glacier in the immediate area back towards Shotgun Creek.

Considering the above, it would appear that the initial target area (following recommendations of the State Assayer and the C&GL of Alaska, Inc.) that Areas I and II should be studied in depth with a drilling program to explore for an underlying (deep-seated?) sulfide body.

DESCRIPTION OF CLAIMS

The following claims are located on Federal Property. Claims were filed individually (20 acres) to avoid single block filing. Federal claims currently held by Northern Lights Exploration Company, Inc. are as follows:

LUCKY BLUE CLAIMS ---------- 100 --------- 2,000 acres

LUCKY GREEN CLAIMS ---------- 200 ---------- 4,000 acres

SHOTGUN CREEK CLAIMS	175	3,500 acres
LITTLE SHOTGUN CREEK CLAIMS	167	3,340 acres
LITTLE RED BED CLAIMS	8	160 acres
Total Federal Claims	650	13,000 acres

The following claims (State of Alaska Prospecting Sites) are located due South of the above described Federal Claims and are on State of Alaska property. Sites were filed in blocks of 160 acres (8 claims) each. Northern Lights Exploration Company has filed ninety (90) sites for a total of 14,400 acres (approximately).

Total Federal and State Claims	1,370
Total Federal and State acreage	27,400

See back flap pocket for enlarged map of Federal area, reproduced from the Healy A-6 Quadrangle Map (magnification 4). Current and correlated sampling and analysis marked to date.

CONCLUSION

Northern Lights Exploration Company is of the opinion, based on the literature of Hawley and Clark, field work conducted in the area, reports of assays and comments of the State Assayer and the Chemical & Geological Laboratories of Alaska, Inc., that the property held by NLEC is a very high potential mineral area, capable of producing a number of metals (including by-products) for many years, profitably.

It is further the opinion of NLEC, based on information, thus far gathered, that the area, properly explored, will reveal a number of workable sites, which with good management will be productive for many years. Initial cost factors for tentatively selected areas for exploration are shown in Appendix D.

The gabbro-basalt mineralized areas are clearly outlined and run parallel (approximately) to each other and the fault zones. The exception is the circular area, approximately 1/2 x 3/4 miles ("Horseshoe Ridge"). A fault zone can be noted, running from Eldridge Glacier to Upper Ohio Creek (through the fissure-vein zone) and next to (almost on contact with "Horseshoe Ridge").. The next gabbro-basalt area also follows a fault line from Eldridge Glacier and ending in Shotgun Creek, again near the fissure-vein (north). Just southeast of this area lies another fault zone, with one just below it. One of these gabbro-basalt zones is 1/2 mile wide by over 7 miles in length (northeast-southwest); the other two areas are less than 1/2 miles apart and are approximately the same width and length (1/4 mile width by about 2 miles in length). These are apparently plutonic intrusions, enriched by the faulting zones (possibly from the batholith to the south?). If the serpentinite was introduced by hydrothermal activity (when water from magmas changed basalt, etc.), then wide-spread hydrothermal activity appears feasible. Consequently, the limestone and basalt (interlayered) as well as other porous materials should be carefully explored for injected mineral deposition.

There may be a similarity in the area of the Upper Chulitna to that, of say, Sudbury, Ontario, Canada, where copper and other valuable metals are found in gabbro.

While Hawley and Clark did not investigate the area south of Eldridge Glacier (State of Alaska property), this region held by Northern Lights Exploration Company, Inc. should also be explored.

Following along with the State Assayer's recommendations and those of Chemical & Geological Laboratories of Alaska, Inc., it seems appropriate to select a target area (such as Shotgun Creek) and fan out from that area.

SUBMITTED BY:

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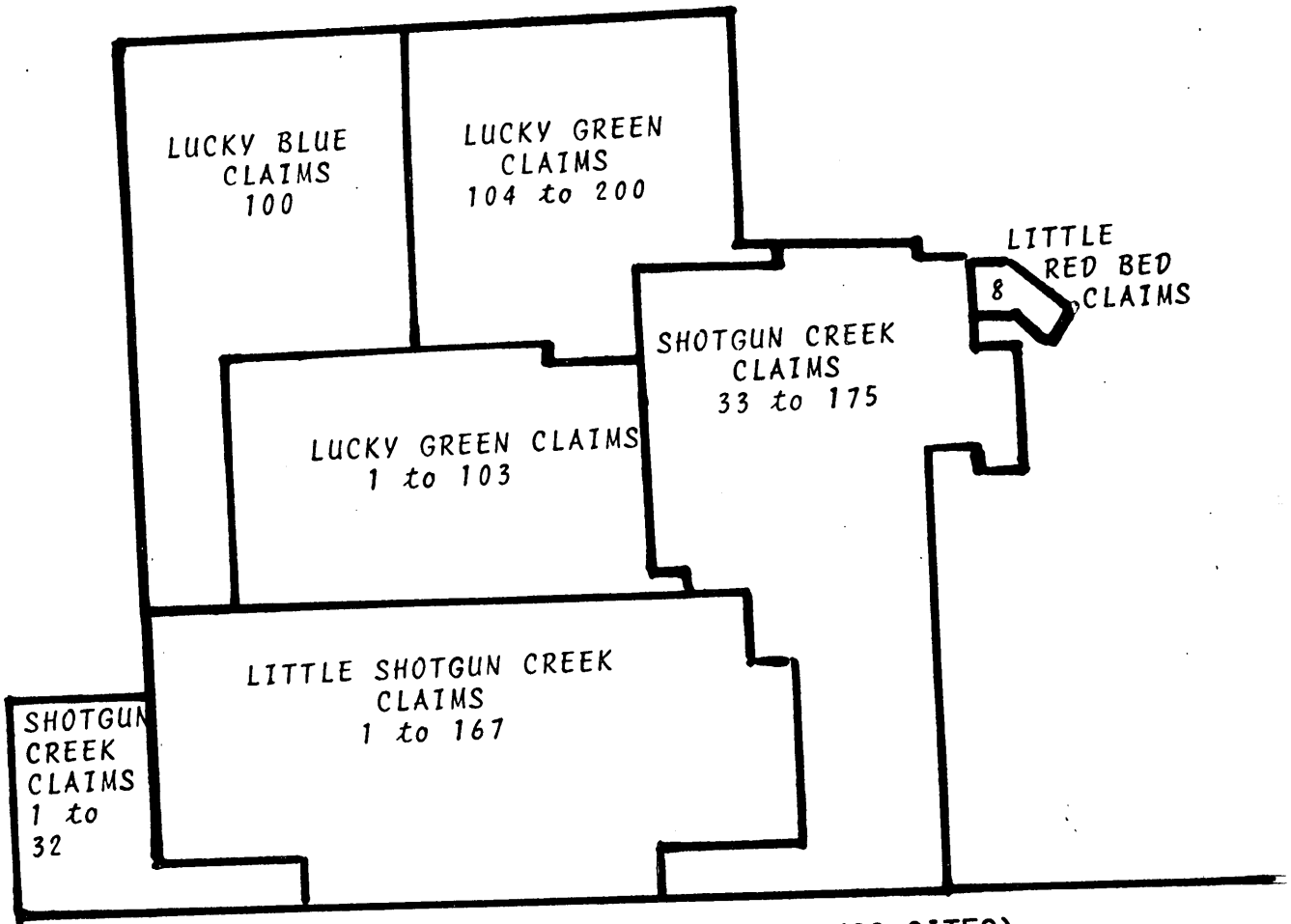
CONCURRED WITH BY:

Archie L. Green
Vice President
Chemical & Geological
Laboratories of Alaska, Inc.

PLATE #1

NORTHERN LIGHTS EXPLORATION COMPANY, INCORPORATED

FEDERAL CLAIMS



NLEC STATE OF ALASKA - PROSPECTING SITES (90 SITES)

LEGEND

Explanation Sheets to enlarged map (Section of Healy A-6) Quad.

NUMBERS:

#1 - (Horseshoe Ridge, in place materials, weathered).
Reed Lab. #3 (6/30/73) - 0.5% Cu.
Reed Lab. #4 (6/30/73) - 0.8% Cu.
Reed Lab. #18 (6/30/73) - 2.4% Cu.
Mineral Lab. #9067 (7/5/73) - 1.1% Cu.
Mineral Lab. #9072 (7/11/73) - 0.739% Cu.

#2 - Talus sample, Shotgun Creek, bottom of fissure vein. C&GL Lab. #1346-1 - 0.57% Cu, (39.5% Fe).

#3 - Cobble, Shotgun Creek, near fissure vein in stream. C&GL Lab. #1346-2 - 0.82% Cu.

#4 - Sample from opposite side (north) of fissure vein on No Name Creek, below red bed outcrop, in place material. C&GL Lab. #1346-3 (12/5/73) - 0.1% Cu.

#5 - Same area as #4; large outcrop running (strike) about 1-1/2 miles, estimated width, 3,000 feet. 0.7% Cu.

#6 - Sample taken near N5, east of Partin Creek. 0.07% Cu. (Indicated as #13 on C&GL Lab.Report).

#7 - Composite sample. Pulverized rock samples from near Eldridge
#8 Glacier. Not NLEC Property. Mineral Lab. Report #9968. 1.128% Cu.

#9 - (upper). C&GL Lab. Report. 1.14% Cu. See C&GL Lab.Report for further details.

#10 - (lower). C&GL Lab. Report. 0.75% Cu. See C&GL Lab.Report for further details.

#11 - C&GL Lab. Report. 0.84% Cu. See report of C&GL Lab. for further details.

#12 - C&GL Lab. Report. 1.34% Cu. See C&GL Lab. Report for further details.

STREAM & SOIL SAMPLES: (Noted as c1 to c7, stream sediments and j1 to j9, soil samples). See C&GL Lab. Report for detailed findings.

"N" NUMBERS:

N1 - State Assay Report. Random grab samples approximately 1 mile south of glacier at head of Shotgun Creek. Cu - 0.7%. See State Assay Report for further information concerning all "N" numbers (Appendix C).

N2 - Ridge, northside of Shotgun Creek. Fissure vein outcrop. 1,000 feet, 400x400 ft. outcrop at top of 12+ vein. 1.45% Cu.

N3 - 1/4 mile east of N2 on southside of Shotgun Creek. 10x10 ft. outcrop. 3.4% Cu.

N4 - Random grab sample from upper Shotgun Creek red bed (northside of fissure vein on unnamed creek. .0075% Cu.

N5 - Approximate location 63°03'N-149°55'W. Eastside of Partin Creek. Grab sample. 0.055% Cu.

N6 - Grab samples northside of Shotgun Creek toward glacier. 2.5% Cu.

N7 - Northside of ridge, north of Shotgun Creek. 500 ft. wide, 1/2 to 3/4 miles north from southside of fissure-vein ridge. 1.58% Cu.

N8 - Float, approximately 1/2 mile south of glacier at head of Shotgun Creek. 1.05% Cu.

N9 - Not listed on enlarged section of map. From area near Eldridge Glacier (not NLEC property). Area shown as #7 & 8 north of Eldridge Glacier.

N10 - Same area and comments as N9 above.

Please see State Assayer's Report for details covering composition of each sample noted.

NOTE: Metals noted by symbol without numbers are stream/soil sediments taken from the Hawley-Clark Reports.

LETTER SYMBOLS:

A, B, C, and D - Gabbro-Basalt bodies (age uncertain, probably between Mesozoic and Teritary?).

E - Interlayered limestone and basalt (Mesozoic).

F - Red beds, limestone, and limy argillite (Mesozoic).

G - Siliceous argillite and interlayered graywacke argillite (Paleozoic).

H - Dark argillite, graywacke, and conglomerate (Mesozoic).

I - Serpentinite (age uncertain, probably between Mesozoic and Teritary?).

SCALE OF ENLARGE MAP (SECTION OF HEALY A-6 QUADRANGLE MAP):

Four inches equal one mile (approximately).

A

CIRC. 617

GEOLOGICAL SURVEY CIRCULAR 617

Results of Geological and Geochemical Investigations in an Area Northwest of the Chulitna River Central Alaska Range

Results of Geological and Geochemical Investigations in an Area Northwest of the Chulitna River Central Alaska Range

By C. C. Hawley, Allen L. Clark, M. A. Herdrick, and Sandra H. B. Clark

GEOLOGICAL SURVEY CIRCULAR 617

Washington 1969

United States Department of the Interior
WALTER J. HICKEL, *Secretary*

Geological Survey
William T. Pecora, *Director*

Free on application to the U.S. Geological Survey, Washington, D.C. 20242

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Results of Geological and Geochemical Investigations in an Area Northwest of the Chulitna River Central Alaska Range

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Abstract

Sedimentary and volcanic rock units of Paleozoic and Mesozoic age, faults, and elongate bodies of intrusive rock, particularly serpentinites, have a dominant northeasterly trend in an area northwest of the Chulitna River between Eldridge Glacier and Bull River. The serpentinites locally contain abnormal (as much as 0.5 percent) concentrations of nickel, have one newly identified occurrence of chromite, and are hosts to small epigenetic lodes containing copper, gold, and silver. Other epigenetic concentrations of copper or other metals occur in interlayered basalt and limestone at Partin and Canyon Creeks in the southwestern part of the area and in porphyry near Costello Creek in the northern part of the area. Tin occurs in greisen on upper Ohio Creek, and abnormal concentrations of tin also characterize mineralized rocks along Canyon Creek and at a prospect near Long Creek. Mineralized rocks characterized by silver, lead, and zinc crop out near Lookout Mountain.

Anomalous concentrations of gold and other metals occur in stream sediments at isolated sites in upper Long Creek and at Coal Creek, as well as in several areas near known lode mineral occurrences. Shotgun and McCallie Creeks both contain stream sediments with anomalous concentrations of metals and both head into the basalt-limestone unit which is the host rock at Partin and Canyon Creeks; these facts suggest that other concentrations may be found.

INTRODUCTION

A mineralized area near the West Fork of the Chulitna River has been known since the early 1900's (Capps, 1919; Ross, 1933). The area, called the Upper Chulitna district (fig. 1), includes the Golden Zone mine and Silver King and Copper King prospects which were investigated by the U.S. Geological Survey in 1967 (Hawley and Clark, 1968).

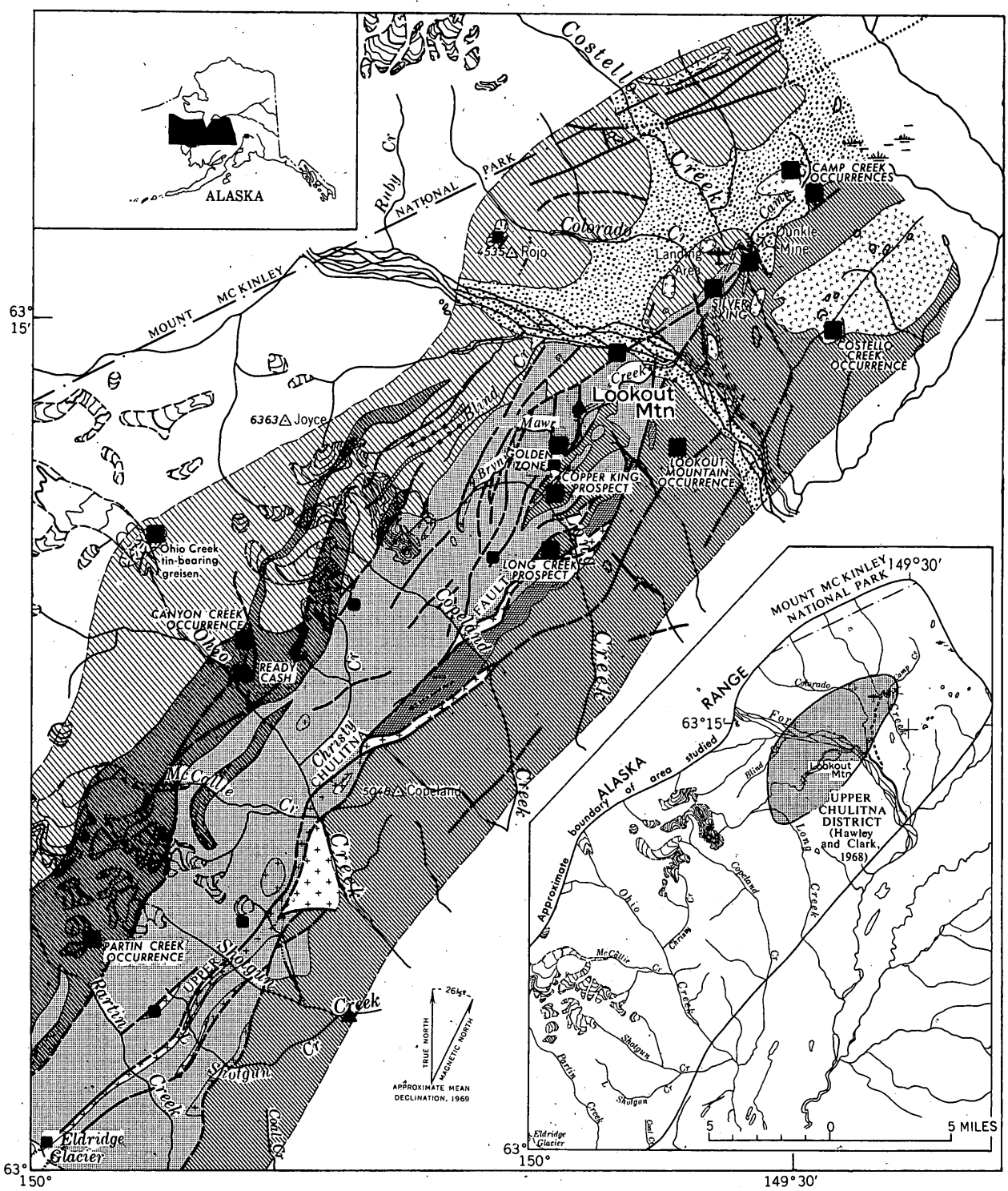
The aim of the investigations in 1968 was to extend geologic mapping and geochemical sampling to areas adjacent to the Upper Chulitna district; this report summarizes geologic findings and emphasizes results that may have economic significance. The main contributions are the recognition of rocks containing unusual concentrations of copper, silver, tin, and other metals at several places and the identification of a belt containing bodies of alpine-type serpentinite. The main copper-bearing localities are near Partin, Canyon, and Costello Creeks; silver is characteristic of rocks near Lookout Mountain; tin is found in greisen in upper Ohio Creek and with arsenopyrite at Canyon Creek.

The report also summarizes the results of stream-sediment sampling; the data are supplemented by a series of geochemical maps in a U.S. Geological Survey open-file report (Hawley and Clark, 1969).

GEOLOGIC SETTING

The Upper Chulitna district and adjoining areas have a strong northeasterly structural grain shown by the orientation of rock layers, folds, and faults, and by the elongation of intrusive bodies of igneous rock (fig. 1).

Layered rocks of Paleozoic and Mesozoic age predominate, but coal-bearing rocks of Tertiary age crop out in the Costello Creek coal fields in the northeastern part of the mapped area (fig. 1). The pre-Tertiary layered rocks can be divided into four main units. The oldest rocks, principally siliceous argillite and interlayered graywacke-argillite, crop out in the southeastern part of the area. They are overlain with angular unconformity by a sequence of red beds and limestones that grade upward into argillite. The red beds contain much volcanic material. Ross (1933, p. 298 and 300) assigned the red beds to the Carboniferous, probably Permian, and the limestones to the Upper Triassic. In some areas a unit of basalt, subordinate mafic intrusive rock, and bedded chert lies



Base from U.S. Geological Survey
1:250,000, Healy, 1956

Figure 1.—Generalized geologic map showing the location of mineral deposits and occurrences in the Upper Chulitna district and an area northwest of the Chulitna River, central Alaska Range.

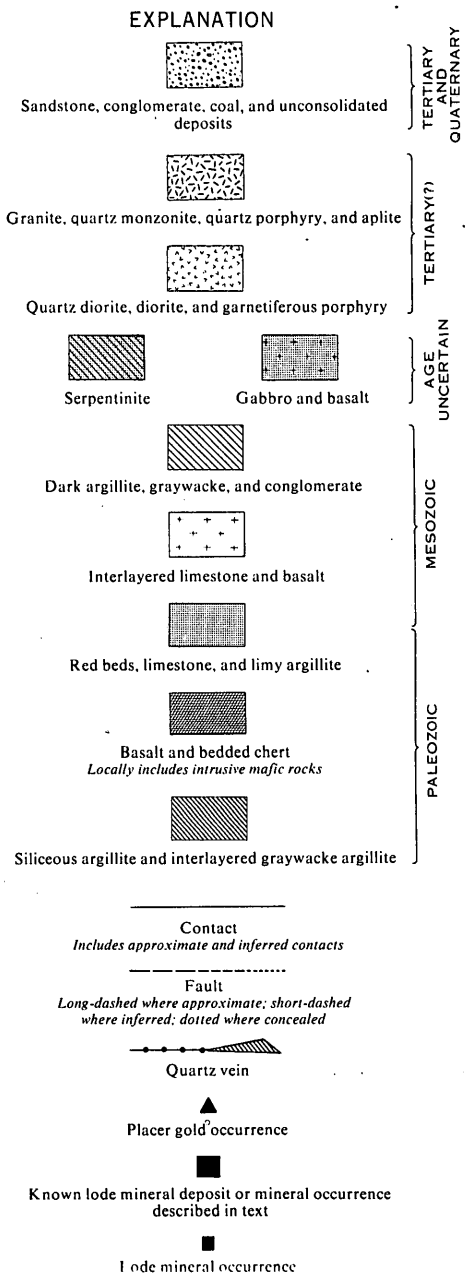


Figure 1.—Continued.

between the argillite-graywacke unit and the red beds. Overlying the argillite in the red-bed and limestone unit is a distinctive unit of interlayered limestone and basalt which apparently thickens southward. The uppermost unit is composed of dark-colored detrital rocks—argillite, graywacke, and conglomerate. A pelecypod, *Buchia sublaevis* (Imlay, not Keyserling), collected from the dark-colored detrital sequence near upper Costello Creek is of Early Cretaceous age (David L. Jones, written commun., 1968).

The layered sedimentary and volcanic rocks are highly folded and faulted. The folds (not shown in fig. 1) are asymmetric anticlines and synclines with northwest-dipping axial planes. Fold axes generally plunge northeastward.

The sedimentary and volcanic rocks of the area are cut by igneous bodies which are ultramafic to granitic in composition. Serpentinite and gabbro are found in a belt along the southeast flank of the area. Granite and porphyry of intermediate composition occur in stocks and numerous bodies too small to show, particularly in the northern part of the area. The igneous rocks were emplaced after folding and some faulting, but before the deposition of the coal-bearing beds of Tertiary age.

Faults, including a complex zone called the Upper Chulitna fault (fig. 1), also trend northeasterly; most are high angle. The Upper Chulitna fault and subsidiary subparallel faults controlled the emplacement of masses of serpentinite and fine-grained gabbro. A second major fault separates the red-bed, limestone, and argillite unit from the interlayered basalt and limestone in the southwest part of the area.

GEOLOGIC STUDIES OF MINERAL DEPOSITS AND OCCURRENCES

The mineral deposits or occurrences of the area comprise syngenetic or nearly syngenetic bodies of chromite and nickel-bearing minerals and epigenetic bodies containing copper, arsenic, gold, and other metals. Chromium and nickel occur in serpentinized ultramafic rocks; epigenetic bodies occur in several host rocks.

The epigenetic deposits and occurrences are distributed widely but are more numerous and larger in the area north of Long Creek (fig. 1). That area contains the known deposit at the Golden Zone mine and the prospects at Silver King and Copper King. Other occurrences include the Long Creek prospect and the ones at Costello Creek and Lookout Mountain (fig. 1). Another zone where epigenetic occurrences seem to be relatively numerous extends northeastward from south of Partin Creek to Canyon Creek in the southwest part of the area.

SYNGENETIC OCCURRENCES IN SERPENTINITE

A discontinuous belt of alpine-type serpentinite bodies can be traced about 25 miles northeastward from Eldridge Glacier to just south of the Dunkle coal mine (figs. 1 and 2). Individual bodies are as much as 1,000 feet thick and can be traced for more than 4 miles; the largest masses are in the Upper Chulitna fault zone. The serpentinite is interesting economically because locally it contains anomalous amounts of nickel, chromium, copper, and gold (table 1).

The serpentinite bodies include dark-green to black massive serpentinite, sheared serpentinite and soapstone, and pale- to dark-greenish-brown quartz-carbonate rock formed by alteration of serpentinite. Most serpentinite samples contain 1,000–3,000 ppm

Table 1.—*Analyses of serpen-*

[Analysts: Joe Curry, R. L. Miller, Buryl Wescott, Richard Tripp, Harriet Neiman, C. L. Forn. Riley, W. D. Goss, and Joseph Haffty. Determination of Fe and Cr on sample 10 by Claude given in percent. Analyses, unless noted, are semiquantitative spectrographic and are re- ing symbols: N, not detected; L, detected but below limit of determination; ---, not looked tion, limit of determination shown in parentheses: Be (1), Bi (10), Cd (20), La (20), Sb 14 (ACL035) and 100 ppm in 18 (AGJ602); Cd, 300 ppm in 18 (AGJ602); La, 20 ppm in 1 (AGJ878) shown in figure 2]

Sample No.	Lab. No.	Field No.	Ag	As	Au[1]	B	Ba	Co	Cr	Cu	Hg[2]	Mo	Mn	Nb
1	AGJ876	S11—H6A	N	N	N	L	70	50	500	[1]750	---	N	1,000	L
	877	H6B	N	N	N	30	N	70	2,000	20	---	N	500	L
	878	H6C	15	N	.1	30	100	200	20	[1]75,000	---	15	15	L
	879	H6D	1	L	.04	30	100	150	150	[1]20,000	---	L	300	L
	880	H6E	.7	N	.02	N	50	5	10	[1]120	---	L	15	L
2	835	ACK293	N	N	N	50	70	150	1,500	L	---	L	700	L
	837	294	N	N	.02	L	50	70	1,500	10	---	L	700	L
3	846	299	N	N	N	L	1,500	50	1,000	150	---	N	1,500	L
	847	301	N	N	N	L	L	50	2,000	7	---	N	2,000	L
4	848	304	N	N	N	30	L	150	2,000	15	---	N	700	L
5	843	ACS811	N	N	N	N	L	50	3,000	7	---	N	1,500	L
6	844	818	N	N	N	L	150	7	30	7	---	N	1,000	L
7	830	CK279	L	N	.06	10	70	50	1,500	200	---	5	1,500	L
	831	279A	.7	L	.04	L	1,000	70	1,500	70	---	L	2,000	L
	832	282	.7	N	.04	20	50	N	300	7,000	---	7	3,000	L
8	840	ACS801	N	N	N	N	L	70	3,000	70	---	N	700	L
	841	802	N	N	N	200	L	500	>5,000	5	---	N	1,000	L
	842	803	N	N	N	L	L	150	3,000	7	---	N	1,000	L
9	874	S6-H50A	N	N	N	50	N	200	>5,000	20	---	L	700	L
	875	B	N	N	N	20	50	70	5,000	50	---	N	700	L
10	ACL536	M824	N	N	---	20	100	100	[3]27	2	---	N	2,000	N
11	901	ACK207A	N	N	N	L	300	50	1,500	70	---	N	300	L
	902	207B	N	N	N	150	N	150	2,000	10	---	N	300	L
	903	207C	N	N	N	70	N	150	2,000	7	---	N	300	L
	904	207E	N	N	N	70	N	150	2,000	15	---	N	300	L
	905	207F	N	N	N	15	N	100	150	L	---	5	2,000	10
	906	207G	N	N	N	10	N	30	150	7	---	N	1,000	L
	AGJ210	ACK210	N	N	.06	20	70	70	2,000	L	---	L	700	L
12	801	201	L	N	.3	20	70	150	1,500	3,000	---	10	500	L
13	803	205	N	N	.02	L	L	70	1,500	10	---	N	700	L
14	ACL035	67HX263	N	300	N	10	20	50	1,500	100	---	N	1,000	L
	037	HX329A	N	N	N	70	5	150	3,000	20	---	N	700	L
	036	HX327	N	N	.02	50	30	5	150	30	---	N	1,000	N
15	ACF063	67AHX177	N	N	N	30	N	100	2,000	5	---	N	700	N
16	ACE614	67HX227	N	N	N	20	N	100	5,000	L	---	L	1,500	30
17	AGJ615	SK40	N	N	N	500	N	200	3,000	20	0.03	N	700	L
	616	SK40B	N	N	N	150	N	200	5,000	50	.01	N	3,000	L
18	601	SK-7	N	L	N	300	N	100	2,000	100	.06	N	700	L
	604	SK-11	.7	300	.02	200	N	150	1,500	30	.08	N	500	L
	602	SK-8	500	>10,000	6.6	30	70	L	15	2,000	2.0	N	15	10
Limits of determination-----			0.5	200	0.02	10	5	5	5	5	0.01	5	10	10

[1] Atomic absorption.
[2] Specific instrumental or chemical method.
[3] Given in percent.

tinite and associated rocks

Fire assay and quantitative spectrographic analyses for platinum-group metals by L. B. Huffman, Jr. Results are given in parts per million except Fe, Mg, Ca, and Ti, which are ported in the series 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, 1,5, and so on, or by the follow- for; H, interference. Looked for but not detected or detected but below limit of determina- (100), Sn (10), and W (50). Exceptions are (lab numbers in parentheses): Bi, 10 ppm in sample and 1 (AGJ879); Sb, 3000 ppm in 18 (AGJ602); and Sn, 10 ppm in 7 (AGJ832). Sample numbers are

Ni	Pb	Pd[2]	Pt[2]	Rh[2]	Sc	Sr	V	Y	Zn	Zr	Fe	Mg	Ca	Ti
150	L	---	---	---	30	200	150	20	200	30	7	3	5	0.2
1,500	L	---	---	---	15	N	30	L	L	N	7	10	L	.03
50	10	---	---	---	5	N	70	L	200	L	20	.3	L	.05
70	L	---	---	---	20	N	200	15	200	20	20	2	.05	.2
L	15	---	---	---	5	N	15	10	L	20	3	.05	N	.2
2,000	N	<0.004	<0.01	<0.005	5	N	30	L	N	L	7	10	L	.01
1,500	10	<.004	<.01	<.005	7	70	30	L	N	L	5	10	3	.005
150	L	---	---	---	70	150	300	10	N	30	10	7	7	.7
1,500	L	---	---	---	5	300	30	L	L	L	5	7	7	.03
3,000	L	---	---	---	7	L	30	L	L	L	10	>10	.3	H
1,500	L	---	---	---	7	300	30	N	N	L	7	7	3	L
30	L	---	---	---	7	N	70	N	N	50	10	.7	.05	.15
700	L	.005	<.01	<.005	15	70	150	15	L	50	7	7	5	.5
1,000	L	<.004	<.01	<.005	10	150	70	10	L	20	7	7	10	.15
100	L	---	---	---	20	N	200	15	L	30	15	7	.07	.3
1,500	L	---	---	---	5	N	N	N	N	L	7	7	1	.007
2,000	L	---	---	---	L	N	20	N	L	L	15	10	.15	.002
1,500	L	---	---	---	15	N	30	N	N	L	N	10	.7	.005
5,000	N	---	---	---	10	N	50	N	L	N	10	>10	L	.007
1,500	L	---	---	---	10	L	70	10	L	30	7	5	1	.15
1,000	N	<.004	<.01	.019	7	10	700	N	N	N	[1]9.1	>10	0.7	0.07
150	N	---	---	---	30	200	150	L	N	30	3	3	.3	.15
1,500	N	---	---	---	7	N	20	N	N	N	3	7	L	.003
1,500	N	---	---	---	5	N	15	N	N	N	3	10	L	.005
1,500	N	---	---	---	L	N	15	N	N	N	3	7	L	.003
100	L	---	---	---	30	1,500	300	30	N	70	10	2	2	.3
200	N	---	---	---	L	N	15	N	N	N	2	L	L	.007
1,000	N	---	---	---	5	150	10	N	N	N	3	3	>20	L
1,500	N	<.004	<.01	<.005	7	70	15	N	200	N	20	7	.7	.005
1,500	N	.004	<.01	<.005	5	300	10	N	N	N	3	7	5	L
1,500	L	---	---	---	5	N	L	N	N	N	7	7	.5	.01
2,000	N	---	---	---	10	N	L	N	N	N	10	>10	.07	<.001
50	L	---	---	---	5	150	30	N	N	L	1.5	10	20	.1
1,000	N	---	---	---	10	N	15	N	N	N	5	7	.7	.007
1,500	L	---	---	---	5	N	15	N	N	N	10	7	.5	.003
5,000	N	---	---	---	5	L	15	N	L	N	15	10	3	L
5,000	N	---	---	---	5	L	15	N	L	N	10	>10	5	L
5,000	L	---	---	---	7	100	50	N	N	N	7	10	5	.015
5,000	10	---	---	---	7	N	10	N	N	N	15	>10	L	L
10	7,000	---	---	---	L	N	20	L	10,000	N	10	L	L	.03
5	10	0.004	0.01	0.005	5	50	10	10	200	20	0.05	0.02	0.05	0.001

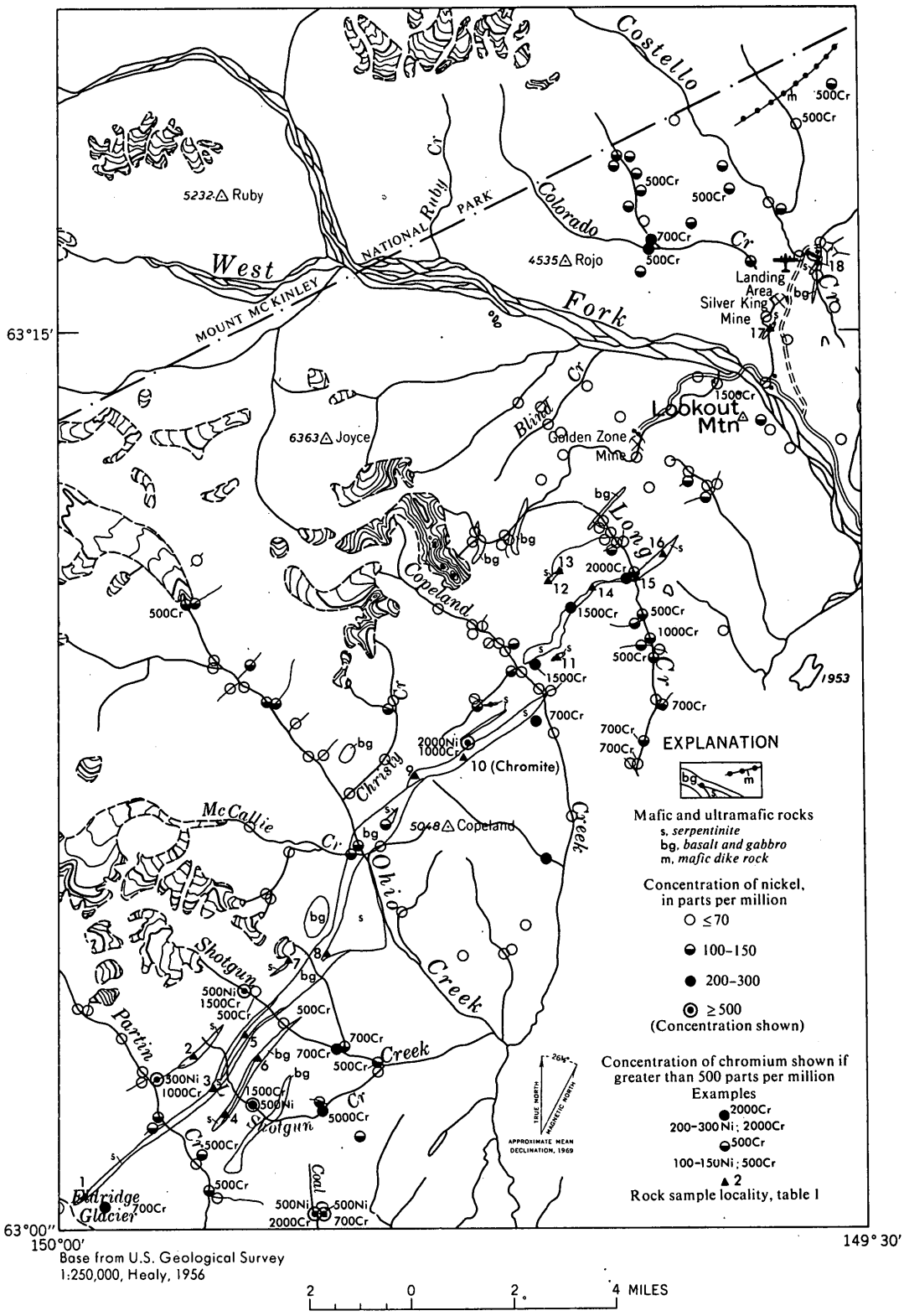
Description of samples given in table 1

Sample No. shown in fig. 2	Lab. No.	Description
1	AGJ876	Malachite-stained serpentinite; staining confined to fracture surfaces.
	877	Blocky massive greenish-black serpentinite.
	878	Pyrite-rich and chalcopyrite-rich (more than 50 percent) rock; quartz matrix.
	879	Pyrite-rich (more than 50 percent) rock.
	880	Vuggy quartz.
2	AGJ835	Serpentinite.
	837	Quartz-carbonate rock. Pyrite locally abundant.
3	AGJ846	Serpentinized basalt cut by jasperoid veinlets.
	847	Altered ultramafic rock, chiefly quartz-carbonate rock; vuggy.
4	AGJ848	Highly sheared serpentinite.
5	AGJ843	Limonite-stained quartz-carbonate rock which forms a 75-foot-wide zone between serpentinite and basalt.
6	AGJ844	20- to 30-foot-wide serpentinite with local quartz-carbonate zones.
7	AGJ830	Dark-green sheared serpentinite.
	831	Serpentinite in fault zone.
	832	Malachite-stained sheared basalt adjacent to serpentinite.
8	AGJ801	5-foot-wide zone of quartz-carbonate rock between basalt and serpentinite.
	802	Serpentinite with well-developed antigorite(?) films in veinlets and on fracture surfaces.
	803	Limonite-stained quartz-carbonate zone about 20 feet wide in serpentinite.
9	AGJ874	Greenish-black massive serpentinite.
	875	Pale-brown quartz-carbonate rock. Disseminated pyrite.
10	ACL536	Massive chromite.
11	ACL901	Altered quartz monzonite; forms the south border of serpentinite mass. Unit about 7 feet wide.
11	ACL902	Quartz-carbonate-rich serpentinite, locally massive quartz-carbonate material. Zone 3 feet wide, adjacent to ACL901.
	903	Dense black serpentinite cut by thin veinlets of sheared antigorite(?). Zone approximately 100 feet wide. Adjacent to ACL902.
	904	Serpentinite.
	905	Sheared and altered basalt. Zone about 25 feet wide. Adjacent to ACL904.
	906	Sheared fibrous material (antigorite(?)) from black serpenitinite (ACL903).
	AGJ210	Jasperoid-calcite rock from small plug in basalt. Basalt is adjacent to serpentinite.
12	AGJ801	Sheared black serpentinite, locally contains inclusions of jade(?). Disseminated pyrite, locally as much as 20 percent.
13	AGJ803	Strongly sheared and silicified serpentinite.
14	ACL035	Sheared serpentinite.
	037	Strongly sheared, greenish-black serpentinite in a fault zone.
	038	Pale-gray bleached brecciated basalt.
15	ACF063	Brownish-white altered serpentinite.
16	ACE614	Dark-grey serpentinized pyroxenite, locally cut by 1/16-inch veinlets of cross-fiber mineral.
17	AGJ615	Massive to sheared greenish-black serpentinite.
	616	Same as AGJ615.
18	AGJ601	Quartz-carbonate rock.
	604	Quartz-carbonate rock.
	602	Arsenopyrite-quartz vein (Eagle vein) on hanging wall of serpentinite body. Vein as much as 1 foot wide, contains 50 percent arsenopyrite.

(parts per million) of both nickel and chromium (table 1) or approximately their normal amounts in ultramafic rocks (Turekian and Wedepohl, 1961). Locally, however, the samples contain as much as 5,000 ppm (0.5 percent) nickel and more than 5,000 ppm chromium. The rocks highest in nickel were found at localities 9, 17, and 18 in figure 2; the rocks highest in chromium, at localities 10 (massive chromite), 8, 9, 16, and 17.

The copper content of serpentinite is generally low, but epigenetic copper occurrences in serpentinite near Eldridge Glacier (locality 1, fig. 2) contain as much as 7.5 percent copper. The serpentinite at locality 1 is cut by irregular and veinlike zones of massive pyrite and chalcopyrite at least 3 feet across. Localities 7, 12, and 18 also have epigenetic occurrences of copper or silver and gold.

Massive chromite (locality 10, fig. 2) is associated with serpentinite that is locally altered to quartz-carbonate rock. The serpentinite body is lenticular and is as much as 1,000 feet across and more than 3 miles long. Locally, the quartz-carbonate rock contains disseminated pyrite and is stained with garnierite. The chromite was not found in place, but massive chromite blocks as much as a foot across were found in talus. A sample of material estimated to contain more than 95 percent chromite contains 39.5



Base from U.S. Geological Survey 1:250,000, Healy, 1956

Figure 2.—Map of serpentinite belt showing concentration of nickel and chromium in stream-sediment samples and location of bedrock samples.

percent Cr_2O_3 and has a Cr_2O_3:Fe_2O_3 ratio of 3.1:1. The chromite has only a trace of platinum metals (sample 10, table 1), principally rhodium.

EPIGENETIC DEPOSITS AND OCCURRENCES

Epigenetic deposits and occurrences described below are characterized by arsenic, copper, and gold; generally subordinate but locally dominant are silver, antimony, lead, zinc, tin, and bismuth.

Mineralized areas in southwestern half of area

Extensive mineralized areas are located near Partin and Canyon Creeks in the southern part of the mapped area (fig. 1). The mineralized area in Partin Creek is probably the one discovered by Albert Partin in 1917 and formerly covered by the Combination and Caribou claims (F. L. Thurmond, unpub. data, 1918). The mineralized area on Canyon Creek includes the Ready Cash prospect (Capps, 1919, p. 228–229; Ross, 1933, p. 318–320) and extends for at least a mile north of it.

Both mineralized areas are west of a major fault that is subparallel to and about 1½ miles to 4 miles west of the Upper Chulitna fault (fig. 1); they are in a unit of interlayered basalt and limestone which is faulted against red beds, argillite, and limestone to the east.

Partin Creek occurrence

Sulfides in the Partin Creek area (fig. 3) occur in a zone at least 3,000 feet long and as much as 1,000 feet wide, elongated parallel to the local structural grain. Rocks within the area contain visible pyrite, arsenopyrite, pyrrhotite, and chalcopyrite. The calcareous rocks of the area are stained with limonite; locally, only a limonite gossan remains. Sulfides in the basaltic units are generally fresh and occur as disseminations and veinlets and locally, in vesicules in amygdaloidal basalt. Analyses of random composite samples of sulfide-bearing rock (samples A–G, I, J) and of a grab sample from a quartz-arsenopyrite vein (sample H) are given in table 2. The samples contain 20–7,000 ppm (0.7 percent) copper, and most contain barely detectable to abundant silver, gold, and arsenic. Analysis of sample K (table 2) is from copper-bearing rocks exposed south of Partin Creek approximately at long. 150°00" W. (fig. 1).

Canyon Creek occurrence and Ready Cash prospect

Mineralized rocks in the Canyon Creek area occur in a unit of basalt and interlayered limestone with minor amounts of hornfelsed argillite (fig. 4). The area containing sulfides is more than a mile long and is elongated subparallel to a north-trending fault. A second fault is inferred in the valley of Canyon Creek. The mineralized bodies are veins of quartz, arsenopyrite, and other sulfides, and sulfides are disseminated in basalt, limestone, and hornfels. Occurrences of mineralized rock were sampled in three parts of the area (fig. 4). Analyses of these samples (samples 1–8, table 3) suggest that copper, arsenic, tin, lead, zinc, silver, and minor amounts of gold are characteristic of the mineralized area. With the exception of tin, these metals or their minerals were reported by Capps (1919) and Ross (1933) at the Ready Cash prospect at the south end of the mineralized area. Tin was detected in all but one sample and exceeds 0.1 percent in one quartz-arsenopyrite-galena vein.

The Ready Cash prospect was sampled and described by Capps (1919), Ross (1933), and F. L. Thurmond (unpub. data, 1918). Thurmond reported a maximum silver assay of 183 oz per ton (ounces per ton) on selected galena from the prospect and a range of 5–120 oz per ton of silver on other sulfide-rich samples. A maximum assay of about 15 oz per ton of silver was determined in samples collected during our brief investigation. Ross (1933, p. 318–320) believed that the numerous vein exposures in the vicinity of the Ready Cash prospect were the result of the faulting of a single lode, but helicopter reconnaissance suggests that there are several distinct veins.

Sulfide mineral occurrences (sample localities 9–12) are also found in precipitous terrain about 2½ miles northeast of the Ready Cash prospect (fig. 4).

A possible extension of the mineralized area exposed near Canyon Creek is indicated by anomalous concentrations of copper or zinc in stream-sediment samples from nearby drainages (fig. 4).

Ohio Creek tin-bearing greisen

A greisen-type tin occurrence was found 3½ miles northwest of the Canyon Creek area on upper Ohio Creek. The occurrence consists of muscovite and tourmaline-bearing greisen and quartz-arsenopyrite veins in a tourmaline-bearing granite stock. The stock is about a mile long and one half of a mile across (fig. 1).

One traverse was made across the part of the stock east of the Ohio Creek Glacier, and greisen was found adjacent to a biotite-rich inclusion. This inclusion is at least 150 feet long and is elongated approximately parallel to a southwesterly trending gulch. A zone of tourmaline greisen as much as 10 feet thick on the south and southeast sides of the inclusion contains as much as 300 ppm tin (lab. No. AGJ976, table 4). The tourmaline greisen grades into muscovite-bearing greisen that is as much as 3 feet thick and contains more than 1,000 ppm tin (lab. No. AGJ975, table 4). Another sample of greisen collected southeast of the gulch also contained more than 1,000 ppm tin (lab. No. AGJ977). The upper 3–10 feet of the granite near its contact with country rock in the northeastern part of the stock locally contains pegmatitic quartz-arsenopyrite veins, and they parallel the 50° NE. dip of the contact. A grab sample of one of these veins contained more than 1,000 ppm tin (lab. No. AGJ978).

Table 2.—*Analyses of samples from the Partin Creek area*

[Analysts: Joe Curry and R. L. Miller. Gold analyses by atomic absorption. Other analyses are semiquantitative spectrographic and are reported in the series 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, 1.5, and so on, or by the following symbols: N, not detected; L, detected but below limit of determination. Results are given in parts per million except Fe and Ti, which are given in percent. Sample localities, except K (south of Partin Creek), shown in figure 3]

Sample Locality	Lab. No.	Field No.	Ag	As	Au	Cu	Mo	Pb	Sb	Zn	Fe	Ti
A	ACL503	68ACK344A	0.7	1,500	0.1	200	L	L	N	L	10	0.5
B	504	344B	N	700	.5	1,500	15	L	N	L	20	.7
C	505	344C	N	N	N	20	L	20	N	N	3	.5
D	506	344D	N	N	.1	300	5	L	N	L	15	>1
E	507	344E	L	N	.9	700	L	L	N	N	10	>1
F	508	344F	N	3,000	.7	700	7	L	N	L	15	>1
G	509	344G	300	N	.1	20	L	N	N	L	7	>1
H	510	344H	1	>10,000	63	7,000	30	100	7,000	300	20	.015
I	511	344I	.5	500	.2	700	7	L	N	L	15	>1
J	512	344J	.5	L	.02	700	10	L	N	200	20	>1
K	AGJ849	68ACK308	N	N	.2	1,500	L	L	N	L	20	>1
Limits of determination----			0.5	200	0.02	5	10	10	100	200	0.05	0.001

Samples of greisen or vein material mentioned above and altered country rocks also contain measurable amounts of silver, gold, copper, lead, zinc, and tungsten (table 4).

Stream sediment from the gulch contains about 150 ppm tin, 200 ppm arsenic, 300 ppm copper, 7 ppm beryllium, 5 ppm silver, 700 ppm zinc, and a trace of tungsten.

Mineralized areas in northeastern half of area

Mineral deposits and occurrences are relatively numerous in the northeastern part of the area (fig. 1), sometimes called the Golden Zone-Silver King mineraized area. Disseminated mineral occurrences were identified in 1968 near Costello Creek 2½ miles east-southeast of the Silver King prospect and in upper Camp Creek 3 miles northeast of the Silver King (fig. 1). The occurrences are in porphyry and, although low grade, seem large enough to warrant further study and sampling. The dominant elements in the Costello Creek deposit are copper, arsenic, and gold; elements present in smaller amounts are silver, bismuth, and tin. Another disseminated mineral occurrence is near Lookout Mountain (fig. 1), where the mineralized rocks contain silver, lead, zinc, and traces of arsenic, gold, and tin. Apparently, neither the Lookout Mountain nor the Costello Creek occurrences have been prospected. An occurrence south of Long Creek has been partly exposed in trenches but not described previously. It is characterized by arsenic, copper, bismuth, tin, and gold.

Costello Creek occurrence

A fine-grained locally garnetiferous diorite porphyry contains sulfides both on fracture surfaces and disseminated over an area about one-fourth of a mile wide by three-fourths of a mile long (fig. 5). The porphyry is part of the stock that underlies the low hills northeast of Costello Creek (fig. 1). Porphyry near samples 1A and 2A (fig. 5, table 5) is estimated to contain from 1–3 percent sulfides; arsenopyrite, pyrite, pyrrhotite, and chalcopyrite are visible megascopically. At sample locality 3A, the rock is brecciated fine-grained porphyry with minor hornfels. At sample localities 3A, 4A, and 5A sulfides are estimated to constitute from ½–2 percent of the rock. A sample (6A) of a granite porphyry dike that cuts diorite porphyry did not contain metals in anomalous concentration.

Camp Creek occurrences

Mineralized rock is exposed over approximately one-fourth of a mile in upper Camp Creek in sec. 5 and near the center of sec. 9, T. 19 S., R. 10 W. (fig. 5). Exposures are poor, but the mineralized rock is altered fine-grained porphyry which protrudes through coal-bearing Tertiary rocks (fig. 5). In sec. 9, an intrusive body is in contact with pre-Tertiary rocks to the east.

The highest metal concentration in samples from Camp Creek (sample 6B, table 5) was 0.6 ppm gold, 500 ppm copper, and 1,000 ppm zinc. Other samples contained appreciably less metal, but mineralization in all samples except sample 1B was indicated by the presence of zinc, bismuth, and antimony.

The occurrences in Camp Creek and mineralized rock north of Costello Creek suggest that mineral deposits may be buried beneath the extensive cover of Tertiary and Quaternary rocks at the north end of the Golden Zone-Silver King mineralized area.

Lookout Mountain occurrence

The mineral occurrence at Lookout Mountain is in a small, locally brecciated, and poorly exposed body of

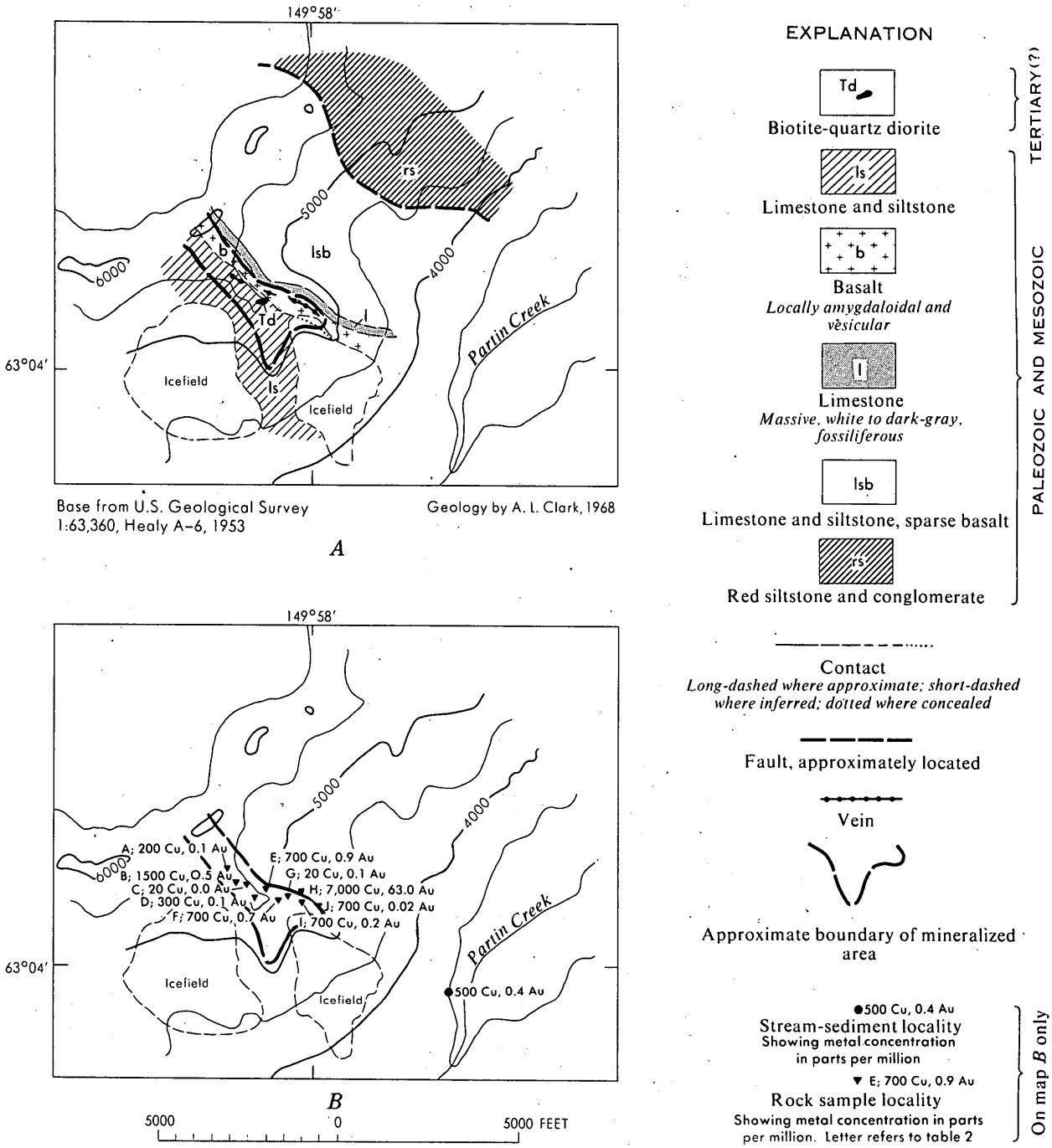


Figure 3.—Maps of the Partin Creek area. *A*, Reconnaissance geologic map. *B*, Sample localities and concentration of copper and gold.

quartz porphyry and felsite emplaced in strongly sheared dark-gray to black argillite and quartzite. Scattered exposures (fig. 6) suggest that the intrusion is roughly circular with a diameter of 1,200 feet.

The intrusive rock is light colored and varies from uniformly fine-grained felsite to quartz porphyry with quartz phenocrysts 2–3 mm (millimeters) in size. Four samples of mineralized intrusive rock collected along the main gulch (samples 1–4, table 5) contain anomalous amounts of zinc, lead, and silver, and trace amounts of tin. A 10-foot-wide dike of quartz porphyry exposed one half of a mile downstream (sample 5) contains traces of the same suite of elements. Shear-zone material in the main intrusive (samples 6 and 7) is also characterized by zinc, lead, silver, and tin, as is

Table 3.—*Analyses of samples from the Canyon Creek area*

[Analysts: Joe Curry and R. L. Miller. Analyses, unless noted, are semiquantitative spectrographic and are reported in the series 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, 1.5, and so on, or by the following symbols: N, not detected; L, detected but below limit of determination. Results given in parts per million except for Fe, which is given in percent]

Sample No.	Lab. No.	Field No.	Ag	As	Au[1]	Cd	Cu	Mo	Pb	Sb	Sn	Zn	Fe
1	AGJ979	S7—9	150	>10,000	0.3	300	[1]7,800	10	1,000	100	300	7,000	15
2	ACJ869	4	500	>10,000	.4	500	3,000	7	>20,000	700	>1,000	10,000	15
3	865	1	7	N	.4	N	5,000	15	N	N	L	L	10
	866	1B	.7	N	.02	N	700	7	N	N	L	N	7
4	867	2	3	700	.06	N	150	7	300	N	L	L	5
5	868	3	3	500	.04	N	300	7	15	N	10	200	10
6	590	M—812	3	L	.02	N	300	L	70	N	700	300	7
7	591	M—814	10	>10,000	.3	N	1,000	10	100	500	150	L	15
	592	814B	3	200	.02	N	700	5	10	N	150	L	10
8	593	815	N	N	.04	N	100	N	L	N	N	N	2
9	881	S6—43	N	N	.1	N	[1]150	5	L	N	N	200	20
10	883	45	2	L	.9	N	[1]4,000	15	L	N	N	L	15
11	884	46	N	N	.1	N	[1]500	L	L	N	N	N	7
12	897	46B	3	700	.8	N	300	5	300	3,000	N	200	10
Limits of determination--------			0.5	200	0.02	20	5	10	10	100	10	200	0.05

[1]Atomic absorption.

Sample No.	*Lab. No.*	*Sample type*	*Description*
1	AGJ979	2-foot chip	Chalcopyrite-arsenopyrite vein in Canyon Creek approximately 100 feet from portal of lower Ready Cash adit.
2	AGJ869	Grab	Quartz-arsenopyrite vein material.
3	AGJ865	Chip	Copper-stained gossan material.
	866	Grab	Iron-stained hornfels.
4	AGJ867	Chip	Iron-stained argillite and quartz-pyrite vein material; inferred fault zone.
5	AGJ868	Grab	Iron-stained basalt unit approximately 30 feet wide.
6	AGJ590	50-foot chip	Reddish-brown altered basalt. Dark-green amygdules.
7	AGJ591	Grab	1½- to 2-foot quartz vein, approximately 50 percent sulfides, mainly arsenopyrite with minor chalcopyrite and tetrahedrite(?).
	592	Grab	Same as AGJ591.
8	AGJ593	Grab	Dark-green to black amygdaloidal basalt.
9	AGJ881	Grab	Contact zone between basalt and limestone.
10	AGJ883	Grab	1- to 1½-foot vein or pod of quartz and sulfides. Near contact of diorite porphyry and hornfelsed argillite.
11	AGJ884	Grab	Sulfide-bearing hornfels. Less than 2 percent pyrrhotite, chalcopyrite, and sphalerite.
12	AGJ897	Surficial	Colluvium below AGJ884.

a limonite-stained sericitic breccia (sample 8). Similar breccia, which contains fragments of both intrusive and country rock, is exposed west of the gully. Silver is also present, but near the limit of detection, in the adjacent clastic country rocks (samples 9, 10, and 11).

Long Creek prospect

Shallow trenches and prospect pits south of Long Creek (fig. 1) expose a weakly mineralized area approximately 300 by 600 feet (fig. 7). Minor amounts of galena, sphalerite, pyrite, and chalcopyrite occur in massive quartz-arsenopyrite veins and as disseminations in the country rock. Sampling of the area (table 5) indicates anomalous concentrations of gold, silver, arsenic, and copper, and minor amounts of molybdenum, bismuth, lead, antimony, tin, and zinc. The metal suite of the occurrence is typical of the area, but bismuth, antimony, and tin are present in larger concentrations and in more samples than in most nearby deposits.

The country rocks of the mineralized area are dense dark-gray hornfelsed conglomerates, breccias, and shales that are cut by a small plug and dikes of quartz porphyry. The metamorphosed country rock contains 1–2 percent disseminated sulfides, primarily pyrite and arsenopyrite with minor amounts of chalcopyrite. The intrusives are stained with limonite and locally contain abundant pyrite and arsenopyrite.

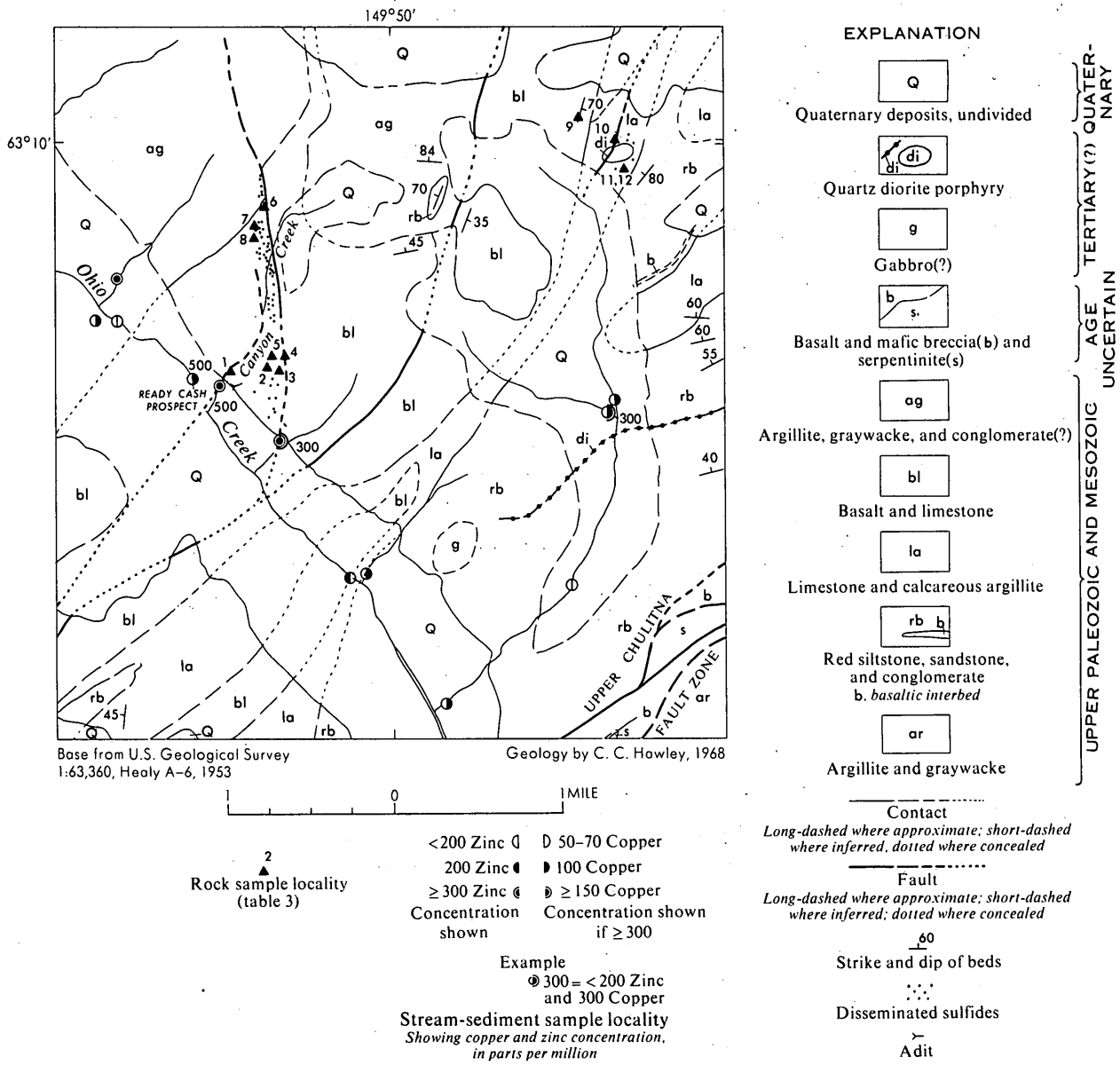


Figure 4.—Geologic map of the Canyon Creek area showing sample locations.

Most exposures in the area are in pits and trenches, and some of these are caved. Massive arsenopyrite vein material was found in place in only two pits (samples A and N, table 5), although massive vein material was also found on four other dumps. This fact and the uniformity of gold content in five of the six samples suggests that vein material may have been moved to some of the pits from one or another of the vein outcrops. Although the significance of the prospect cannot, therefore, be assessed without further sampling, the country rocks are sulfidized. Vein materials contain gold and appreciable amounts of silver, bismuth, and tin, and sediment in the stream draining the prospect area shows 7 ppm Ag and 70 ppm Pb (Hawley and Clark, 1968, sample 44, table 3).

GEOCHEMICAL ANOMALIES IN STREAM SEDIMENTS

One hundred and sixty five stream-sediment samples, including some duplicates, were collected in the area in 1967 and 1968. The samples were collected, where possible, from active streams, and the -80 mesh fraction was analyzed for gold by an atomic-absorption method and for 30 other elements by a semi-quantitative-spectrographic method.

Of those elements, silver, gold, copper, lead, zinc, and arsenic occur in enough samples and had sufficient range in concentration to be generally useful in determining anomalies. Medians, shown below, and limits of anomalous concentrations were estimated from

Table 4.--*Analyses of samples from the Ohio Creek occurrence*

[Analysts: Joe Curry, R. L. Miller, R. Tripp, W. R. Vaughn, and E. E. Martinez. Analyses, unless noted, are semiquantitative spectrographic and are reported in the series 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, 1.5, and so on, or by the following symbols: N, not detected; L, detected but below limit of determination; H, interference. Results are given in parts per million]

Lab. No.	Field No.	Ag	As	Au[1]	B	Be	Bi	Cd	Cu	Mo	Pb	Sb	Sn	W	Zn
AGJ973	S7—6A	3	L	0.04	>2,000	5	L	N	10	N	30	N	15	70	700
974	6B	5	N	.04	>2,000	5	10	150	150	L	50	L	200	L	2,000
975	6D	30	3,000	.04	H >50	3	30	50	150	N	200	L	>1,000	150	L
976	6F	7	L	.04	>2,000	5	20	N	1,500	L	20	N	300	N	700
977	6G	70	300	.02	30	15	N	N	150	N	30	N	>1,000	50	L
978	6I	20	>10,000	.04	30	3	20	N	1,000	L	300	150	>1,000	30	L
Limits of determination--		0.5	200	0.02	10	1	10	20	5	5	10	100	10	50	200

[1]Atomic absorption.

Lab. No.	*Description*
AGJ973	Quartz-tourmaline veined granite (in float).
974	Mica schist (in float, possibly from inclusion).
975	Muscovite-quartz-arsenopyrite greisen adjacent to tourmaline greisen AGJ976.
AGJ976	Tourmaline greisen.
977	Quartz-muscovite greisen exposed.
978	Quartz-arsenopyrite vein parallel to contact of granite and country rock.

cumulative frequency distribution diagrams. These are given with geochemical maps in the supplementary open-file report (Hawley and Clark, 1969).

Element	*Median*	*Lower limit of anomalous concentrations* (parts per million)
Ag------	<0.5	0.5
As------	<200	Detected (limit of determination is 200 ppm)
Au------	<.02	.02
Cu------	70	150
Pb------	15	30
Zn------	<200	200

Because of the high limits of detectability of silver, arsenic, gold, and zinc compared to their relative scarcity in the area, medians could not be calculated directly. However, projections on the cumulative frequency diagrams show that the median concentrations are probably less than one-half of the limit of anomalous concentration. Antimony and tin are found in a very few samples; these elements are likewise scarce compared to their analytical detectability and are considered anomalous if seen spectrographically.

Elements such as copper and gold (listed in the preceding section) are found locally in anomalous concentrations in stream sediments not only below known occurrences but also in drainages in which metallized rocks have not yet been found. The analyses presented graphically in the companion open-file report (Hawley and Clark, 1969) are summarized in figure 8. The map shows which elements are present in anomalous concentrations in stream-sediment samples of the area.

ANOMALIES RELATED TO KNOWN DEPOSITS OR OCCURRENCES

Anomalies related to known occurrences are found in several areas, such as near Lookout Mountain, the Long Creek prospect, Golden Zone, Canyon Creek, upper Partin Creek, and the Ohio Creek tin-bearing greisen. Maximum metal concentrations in stream sediments from these areas are shown in table 6. In the upper Partin Creek area, anomalous concentrations of one or more metals persist at least 2 miles below the occurrence; in Bryn Mawr Creek, below the Golden Zone, several elements persist for more than 2½ miles, and arsenic remains at or above 3,000 ppm to the mouth of the creek. Mineralization in and near Canyon Creek is marked mainly by high metal concentrations in tributary valleys but not in the broad alluviated valley of Ohio Creek. In the upper Ohio Creek area, maximum concentrations of tin and other elements and visible greisen (northernmost sample) are found in the gulch. However, the presence of copper, antimony, zinc, and a trace of tin and tungsten in a tributary to Ohio Creek below the occurrence suggests that related mineralization extends east of the granite stock into the next drainage basin.

ANOMALIES OF UNKNOWN ORIGIN

Anomalies of unknown origin are grouped into two types: (1) Those with abundant metals, and (2) those with metal concentrations at or near the limit of anomalous values. The concentrations in the first type are similar to those found below known metal occurrences and probably indicate nearby mineralized rocks. The anomalies in Coal Creek and Long Creek (fig. 8) are of this type; both show gold equal to or greater than 0.1 ppm, while the Coal Creek sample has 3 ppm Ag and 700 ppm Zn, and the richest Long Creek sample

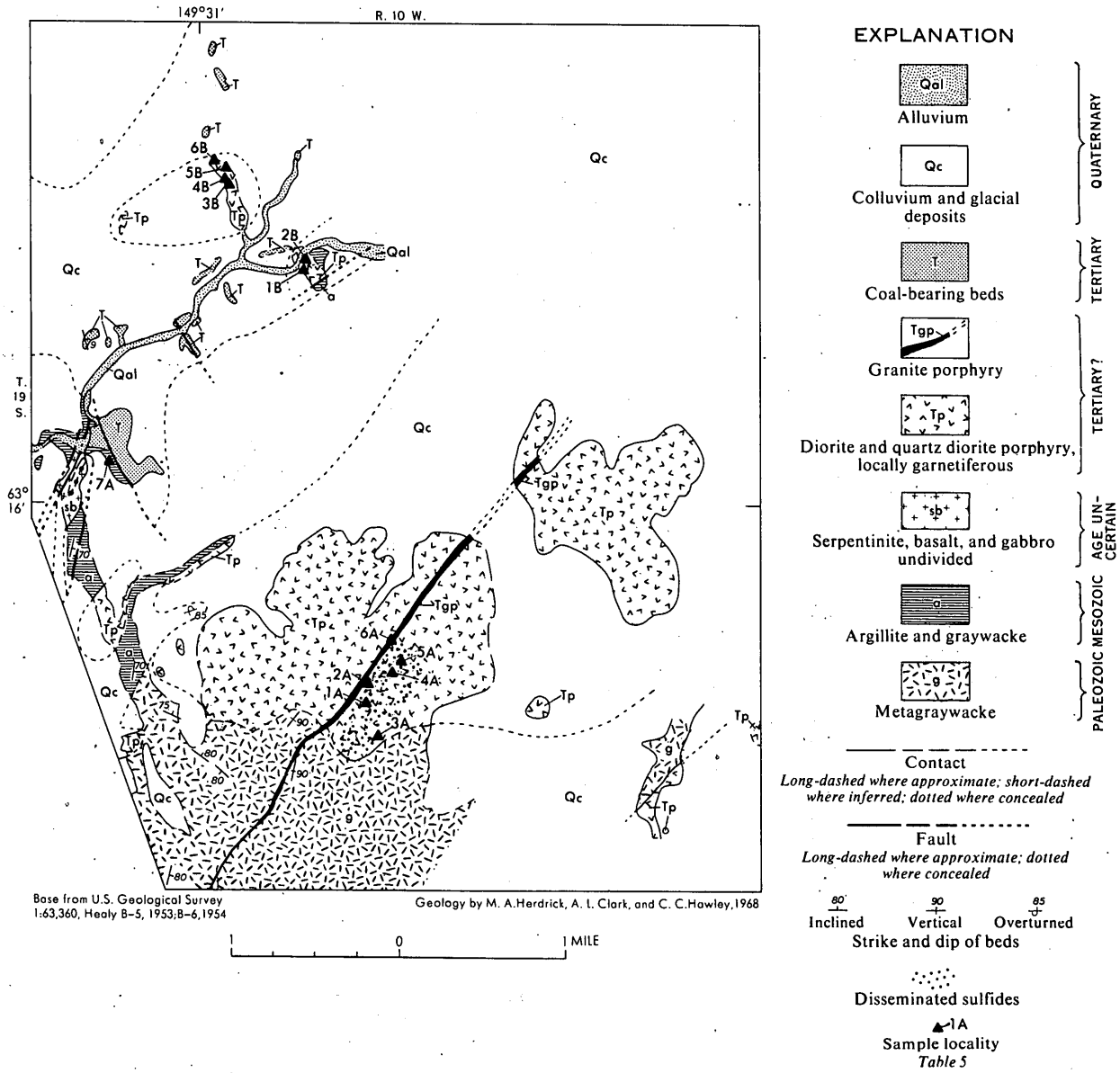


Figure 5.—Geologic map of the northeastern part of the Golden Zone-Silver King mineralized area showing sample locations.

has 500 ppm As and 150 ppm Cu. A high concentration of chromium and nickel at Coal Creek (fig. 2) suggests that metallized rocks may occur in or near serpentinite.

Anomalies of the second type are represented mainly by samples from Shotgun and McCallie Creeks and from the upper Costello Creek area (fig. 8). Shotgun and McCallie Creeks head in the interlayered basalt-limestone terrane (fig. 1), which is the host rock of deposits at Partin and Canyon Creeks; both streams have multiple-element anomalies. In contrast, only one of four samples from Little Shotgun Creek, which heads in red beds, has an anomalous amount of metal. The metals found in Shotgun and McCallie Creeks are gold, copper, and, less commonly, zinc, arsenic, and antimony. These metals also characterize the occurrences at Partin and Canyon Creeks, and the data suggest that hitherto undiscovered mineral occurrences may be located in the limestone-basalt terrane between these two areas. The metal concentrations of the samples from Shotgun and McCallie Creeks are near the limit of anomalous concentrations; that is, gold ranges only from 0.02–0.06 ppm, copper is 150 ppm, arsenic and antimony are barely detected, and zinc is 200 ppm. Although these relatively low concentrations may indicate only weak metallization, most of the sample sites are more than a mile from the most likely host for lode occurrences—the limestone and basalt—and could, therefore, indicate normal downstream dilution of an anomaly.

Table 5.—*Analyses of samples from occurrences in the Golden Zone-Silver King mineralized area*

[Analysts: Joe Curry, E. E. Martinez, and R. L. Miller. Gold analyses by atomic absorption. Other analyses are semiquantitative spectrographic and are reported in the series 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, 1.5, and so on, or by the following symbols: N, not detected; L, detected but below limit of determination. Results are given in parts per million except Fe and Ti, which are given in percent. Samples 1—5 (from Lookout Mountain) taken from felsite and quartz porphyry, samples 6 and 7 from a shear zone, sample 8 from breccia, and samples 9—11 from black argillite and quartzite]

Sample No.	Lab. No.	Field No.	Ag	As	Au	Bi	Cd	Cu	Mo	Pb	Sb	Sn	Zn	Fe	Ti
Costello Creek (sample localities shown in fig. 5)															
1A	AGJ645	HB6—M53	0.7	>10,000	0.3	150	N	500	L	10	N	15	N	15	0.7
2A	646	M54	.5	200	.4	30	N	1,000	N	L	N	L	N	20	1
3A	956	MH—835	L	N	N	N	N	70	N	L	N	15	N	10	.5
4A	957	836	.7	300	.3	30	N	150	L	N	N	N	L	7	.3
5A	958	837	3	400	N	30	N	700	L	N	N	50	L	10	.7
6A	959	837B	L	L	N	N	N	10	N	20	N	L	L	3	.15
7A	641	HB6—M44	7	N	.2	N	N	500	N	L	150	N	N	5	.7
Camp Creek (sample localities shown in fig. 5)															
1B	AGJ630	68ACK140	L	N	N	N	N	70	N	10	N	N	N	5	0.2
2B	631	141	L	N	N	L	N	70	L	15	150	N	L	10	.5
3B	632	147	L	L	.02	L	N	10	N	100	N	N	L	10	.5
4B	633	148	L	N	N	L	N	100	L	150	L	N	700	7	.5
5B	634	149	.5	L	N	L	N	10	7	50	L	N	500	7	.5
6B	635	150	.7	N	.6	L	30	500	20	50	150	N	1,000	15	1
Lookout Mountain (sample localities shown in fig. 6)															
1	AGJ935	68ACs858D	10	N	N	N	N	20	N	300	N	10	500	3	0.05
2	936	858E	15	L	N	N	N	10	N	150	L	30	500	2	.05
3	937	858F	3	L	N	N	N	15	N	150	N	15	500	3	.05
4	939	866	30	L	.04	N	N	150	L	700	L	50	L	7	.5
5	941	868B	.7	N	N	N	N	20	L	1,500	300	50	700	3	.2
6	933	858B	3	N	N	N	N	30	N	150	N	15	500	5	.5
7	934	858C	3	N	N	N	N	100	L	70	N	10	200	7	.5
8	938	861	15	N	N	N	N	20	N	500	L	30	700	3	.15
9	932	857	1	N	N	N	N	20	L	30	N	10	N	3	.7
10	697	862	1	N	N	N	N	20	L	30	N	L	N	3	.5
11	940	867	.5	N	N	N	N	20	N	L	N	N	L	3	.3
Long Creek prospect (sample localities shown in fig. 7)															
A	AGJ809	68ACK230A	500	>10,000	2.8	300	500	3,000	7	3,000	3,000	100	>10,000	20	0.01
B	810	B	1	L	.2	15	N	500	L	20	N	N	L	7	.3
C	811	C	200	>10,000	3.2	500	70	1,000	7	1,500	1,500	N	3,000	20	.03
D	812	D	2	1,500	.2	L	N	300	L	30	N	N	N	7	.2
E	813	E	1	N	.04	N	N	200	L	15	N	N	L	5	.3
F	814	F	2	N	.1	N	N	200	L	15	N	N	N	7	.5
G	815	G	.7	300	.06	N	N	200	L	10	N	N	N	7	.5
H	816	H	100	>10,000	3.1	150	N	3,000	7	1,000	1,500	10	300	>20	.02
I	817	I	.7	300	.06	L	N	300	L	15	N	N	L	7	.5
J	818	J	1.5	200	.06	L	N	300	5	20	N	L	L	7	.5
K	819	K	5	300	.3	15	N	500	L	50	100	L	L	7	.3
L	820	L	70	>10,000	3.6	150	N	700	7	300	1,000	L	300	15	.03
M	821	M	L	L	.04	N	N	150	L	N	N	N	N	1.5	.15
N	822	N	5	>10,000	11	1,000	N	700	7	50	500	N	N	10	.07
O	823	O	L	L	.04	N	N	200	L	10	L	L	L	7	.5
P	824	P	L	300	.06	N	N	150	L	10	N	L	N	3	.03
Q	825	Q	L	N	.04	N	N	150	L	L	N	L	L	7	.5
R	826	R	7	3,000	.2	10	30	700	L	200	L	100	700	7	.3
S	827	S	700	>10,000	3.2	150	500	3,000	7	3,000	2,000	700	>10,000	>20	.015
T	828	T	1.5	500	.06	N	N	150	5	30	N	15	300	7	.5
X	829	232	70	1,500	1.9	300	N	1,500	7	100	N	15	200	20	.3
Limits of determination--------			0.5	200	0.02	10	20	5	5	10	100	10	200	0.05	0.001

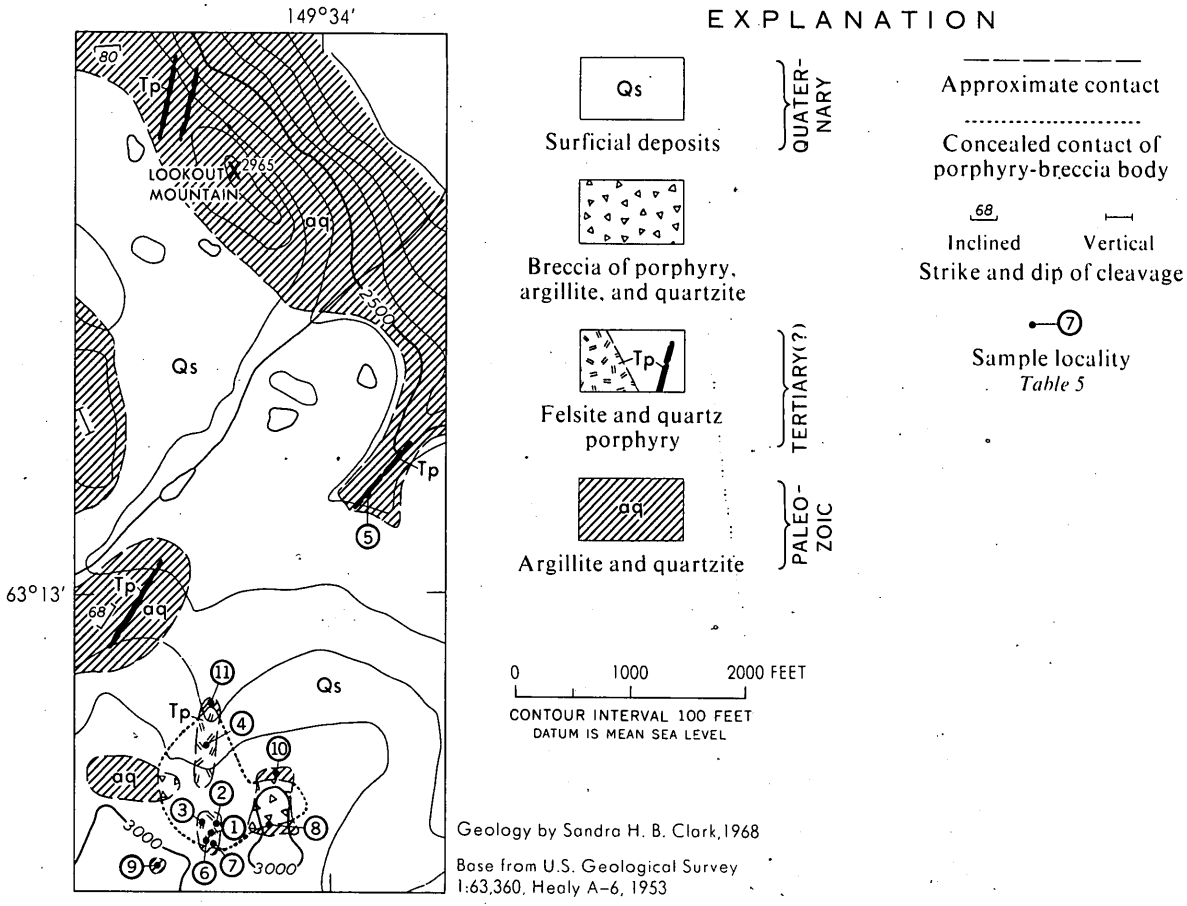


Figure 6.—Geologic map of the Lookout Mountain area.

Table 6.—*Maximum element concentrations, in parts per million, in stream-sediment samples below known deposits and occurrences*

[N, not detected; L, detected but below limit of determination]

	Lookout Mountain	Long Creek	Golden Zone	Canyon Creek	Partin Creek	Ohio Creek
Ag----	0.7	7	3	2	0.7	15
As----	200	N	5,000	200	700	200
Au----	N	N	.7	.02	.4	N
Cu----	150	70	300	500	500	300
Pb----	70	70	200	70	30	20
Sb----	N	N	N	L	L	L
Sn----	N	N	N	150	N	200
Zn----	500	L	200	500	200	700

Anomalous concentrations of zinc, arsenic, copper, and lead seem to characterize an area drained by upper Costello Creek. The same elements, especially zinc, are also found at several sites in lower Ohio, Copeland, and Long Creeks, and anomalous concentrations of zinc occur in upper Long and Copeland Creeks and in the area due west of the Golden Zone. The concentrations of the elements found in upper Costello Creek and the other sites mentioned are generally near the minimum for an anomaly; that is, in parts per million: Ag, 0.5–0.7; As, detected; Cu, 150; Pb, 30; and Zn, 200–300. The distribution of these low values suggests a broad mineralized zone centered around the Golden Zone-Silver King area.

SUMMARY AND RECOMMENDATIONS FOR PROSPECTING

Deposits or occurrences of copper-, gold-, silver-, and tin-bearing rocks are widely distributed throughout the area studied (fig. 1), and anomalous amounts of chromium or nickel are found at scattered localities along a linear zone of serpentinites (fig. 2). Although many of the known occurrences appear to be small or of low grade, the potential of the area appears good because of (1) the total number of occurrences, (2) the presence of favorable host rocks such as limestone, basalt, and tuff, (3) the diverse elements contained in the mineralized rocks, and (4) the existence of a known significant deposit at the Golden Zone.

An attractive site for exploration is the elongate Partin Creek-Canyon Creek mineralized area. The occurrences in the area are poorly known, but sulfidized rocks crop out over distances measured in thousands of feet at Partin Creek and Canyon Creek, and the host rocks are favorable for replacement deposits. The geochemical anomalies in Shotgun and

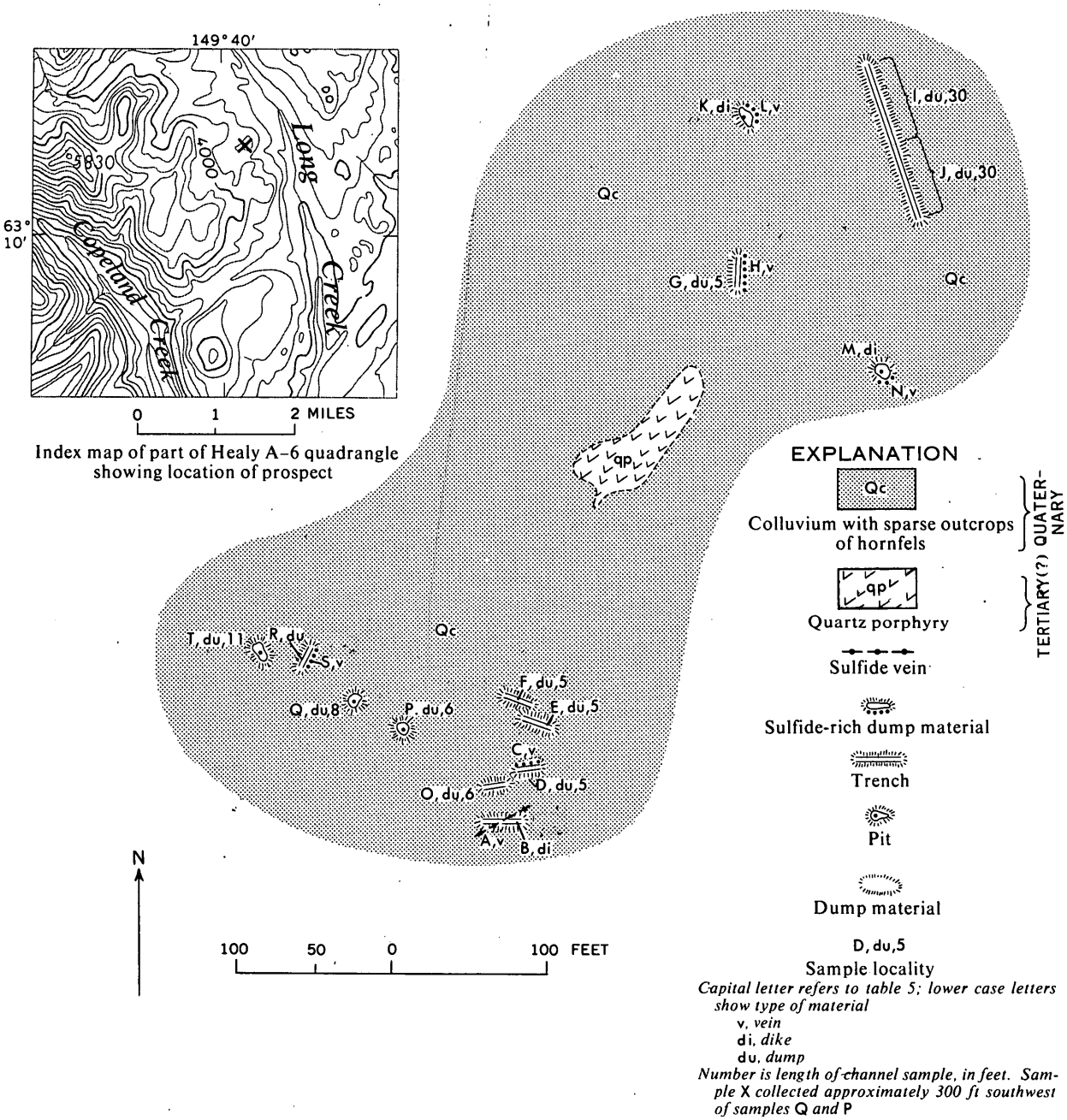
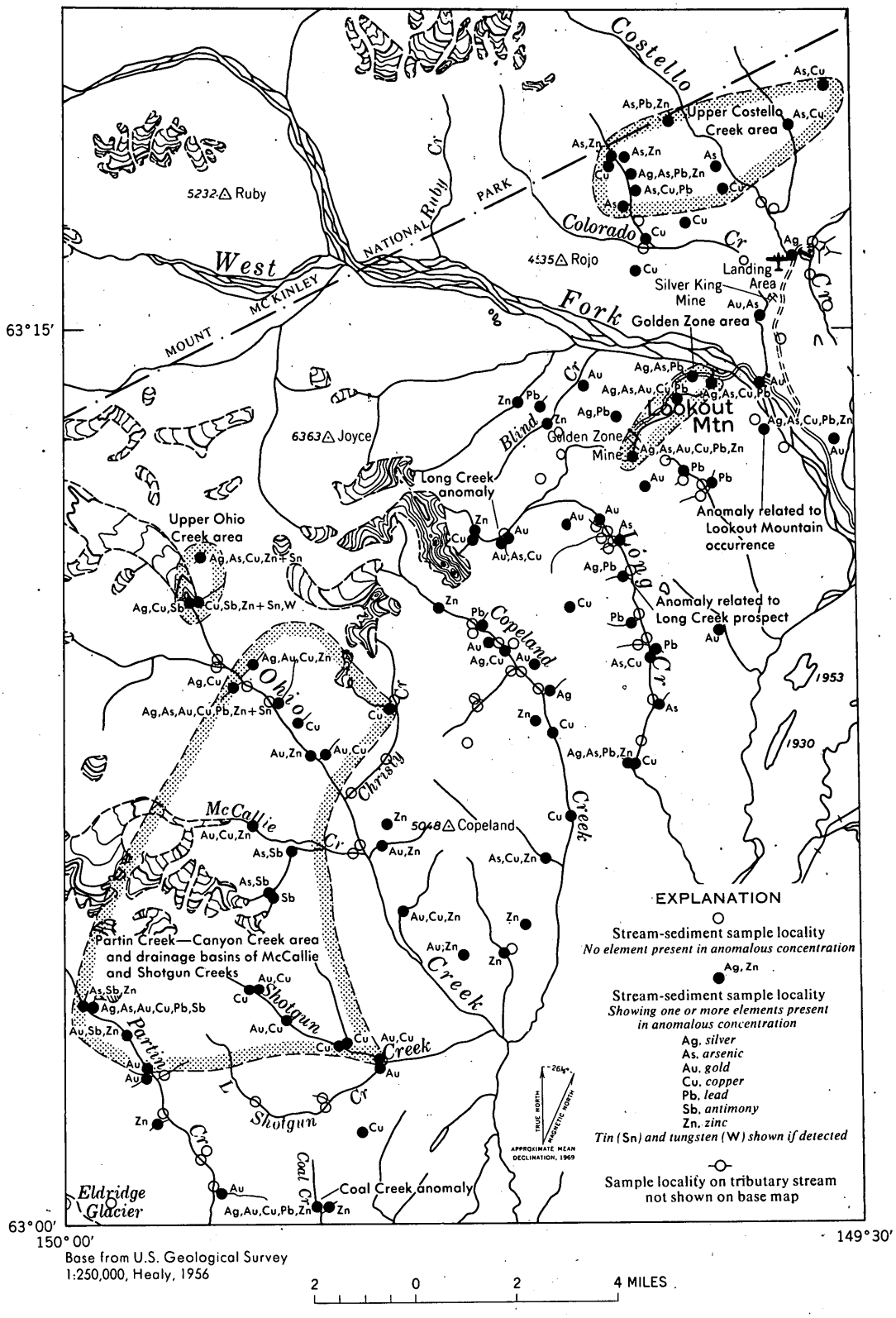


Figure 7.—Map of Long Creek prospect showing sample locations.

McCallie Creeks are probably caused by undiscovered mineralized rocks in the limestone and basalt in the headwater areas.

The granite with tin-bearing greisen in upper Ohio Creek has not been thoroughly investigated, and the amounts of tin at Canyon Creek and the Long Creek deposit are of interest.

The discovery of mineral occurrences in the northern part of the area near Costello and Camp Creeks suggests that sparse outcrops north of that area, such as the outcrops along the Bull River, should be examined.



Base from U.S. Geological Survey 1:250,000, Healy, 1956

Figure 8.—Elements present in anomalous concentration in stream-sediment samples.

SELECTED REFERENCES

Capps, S. R., 1919, Mineral resources of the upper Chulitna region: U.S. Geol. Survey Bull. 692, p. 207–232.

Hawley, C. C., and Clark, A. L., 1968, Occurrences of gold and other metals in the Upper Chulitna district, Alaska: U.S. Geol. Survey Circ. 564, 21 p.

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Turekian, K. K., and Wedepohl, K. H., 1961, Distribution of the elements in some major units of the earth's crust: Geol. Soc. America Bull., v. 72, no. 2, p. 175–192.

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.—1969

STATE OF ALASKA

WILLIAM A. EGAN, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

Box 80007, College, Alaska 99701

December 19, 1973

Raymond W. Voss
729 Ocean Drive
SRA Box 1450-A
Anchorage, Alaska 99502

Dear Mr. Voss:

Your rocks are typical of the rocks and analysis described in USGS Circular 617 and Professional Paper 758-A. The basalt-gabbro-serpentine contains very little zinc so consequently sample N5 may indicate an area similar to EG 1 and EG 2 by zinc comparison. Four out of ten of your samples are over 1% copper related to hydrothermal deposition in the basalt-gabbro. Other analysis in Circular 617 indicate that the basalt-serpentine does not have a uniformily high copper mineralization, but does probably show a local concentration effect. Pinpointing the areas of local concentration and fanning out from these prospecting centers may indicate a deposition pattern upon which exploration can be based. Drilling in these areas of local concentration will most certainly help evaluate the pattern of deposition. Structural controls such as faults, folds and joints should be prospected as well as the basalt-limestone interlayered areas and the contact areas.

One sample showing over 1% copper is of the quartz arsenopyrite copper, lead, zinc type deposition and may be related to hydrothermal activity from the acid igneous rocks in the area. Since deposits are found in the Canyon and Partin Creek area with a similar geology to yours in Shotgun Creek, namely hydrothermal deposition of sulfides into interlayered basalt-limestone from fault or igneous rock activity, the possibility of an ore zone being present in this rock type is favorable.

Very little magnetite is indicated in your samples. Asbestos should be looked for in the serpentinized areas. Mercury is not indicated in Circular 617 to be a viable prospecting commodity in the area. Only traces of it are reported in the Costello Creek-Camp creek area.

In answer to question #10, the Paleozoic basalts contain chalcopyrite and native copper which might possibly be primary, but not uniformly distributed in the basalt. Paleozoic basalts at other locations in the world are known to contain trace amounts of native copper. However, the arsenic, copper lead, zinc, gold, silver, tin, and tungsten are probably related to the later more acid igneous rocks and the presence of this mineral assemblage in basalt-gabbro is probably epigenitic.

In answer to question #11, zoning haloes probably will surround the acid igneous intrusives as illustrated by the Golden Zone pluton, but probably will not surround the basalt flows. Almost any low to intermediate temperature element, if present in the magma in sufficient quantity, can be used as a zoning indicator, but it takes several elements and their characteristic host rock deposition affinity to realistically defind a zone or lack of a zone.

In answer to question #12, on your wide fissure vein, I suggest first a good surface sampling program and, if this proves to be favorable, follow up with several shallow and a few deep drill holes.

If I can be of any further assistance to you, please let me know.

Best regards,

Donald R. Stein

Donald R. Stein
State Assayer

Enclosure: Laboratory Analysis Report

1
10/67

: OF ALASKA
rtment of Natural Resources
ION OF MINES AND GEOLOGY
C, C[illegible]e, Alaska 99701

Report No. 3192

Date of Report December 18, 1973

LABORATORY ANALYSIS REPORT

R. W. Voss

Address 729 Ocean Drive SRA Box 1450-A
Anchorage, Alaska 99502

Date Sample Received 11/6/73

nber of Samples 10

Done: Analyst below)
A. X-ray flourescence quant. ☐ semi-quant. ☐
B. X-ray diffraction ☐
C. Spectrographic quant. ☐ semi-quant. ☐
D. Spectroscopic ☐
E. Atomic absorption quant. ☐ semi-quant. ☐
F. Fire assay ☐
G. Microscopic examination ☐
H. Other (Specify) ☐
I. Ultraviolet light ☐

ANALYSIS OR IDENTIFICATION

ABORATORY NUMBER	SAMPLE MARKED	E. Ounces Per Ton		E. Weight Per Cent				
		Gold	Silver	Copper	Lead	Zinc	Molybdenum	Nicke
41640	N1	Nil	0.075	0.7000	0.0020	0.0060	Nil	0.003
41641	N2	Nil	0.023	1.45	0.0020	0.0020	0.0003	0.005
41642	N3	Nil	0.58	3.40	0.0025	0.0025	0.0001	0.005
41643	N4	Nil	0.034	0.0075	0.0025	0.0025	Nil	0.021
41[illegible]	N5	Nil	0.076	0.0550	0.0035	0.2100	0.0005	0.007
41645	N6	Nil	0.061	2.50	0.0023	0.0025	Nil	0.006
41646	N7	0.004	0.116	1.58	0.0023	0.0140	0.0001	0.005
41647	N8	0.045	0.60	1.05	0.0025	0.0080	Nil	0.003
41648	EG 1	Nil	Nil	0.1700	0.0005	0.0450	Nil	0.010
41649	EG 2	Nil	0.002	0.1850	0.0015	0.4300	Nil	0.010

	Aqua regia soluable iron and calcium %	
N1	12.0 - Iron	0.5 - Calcium
N2	6.0	0.7
N3	8.5	1.8

con't

ANALYST & WORK DONE

ANALYST & WORK DONE

ANALYST & WORK DONE

APPROVED: LABORATORY SUPERVISOR

NOTE: Samples discarded after 60 days and pulps after 6 months unless instructed otherwise.

MOORE BUSINESS FORMS, INC. M

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v. 10/67

ATE OF ALASKA
partment of Natural Resources
VISION OF MINES AND GEOLOGY
x C, [illegible]age, Alaska 99701

Report No. 3[illegible]2

Date of Report December 18, 1973

LABORATORY ANALYSIS REPORT

or R. W. Voss

Address

umber of Samples

Date Sample Received

rk Done:
Analyst
below)

A. X-ray flourescence quant. ☐ semi-quant. ☐
B. X-ray diffraction ☐
C. Spectrographic quant. ☐ semi-quant. ☐
D. Spectroscopic ☐
E. Atomic absorption quant. ☐ semi-quant. ☐
F. Fire assay ☐
G. Microscopic examination ☐
H. Other (Specify) ☐
I. Ultraviolet light ☐

LABORATORY NUMBER	SAMPLE MARKED	ANALYSIS OR IDENTIFICATION	
		Aqua regia soluable iron and calcium %	
	N4	3.5 - Iron	11.7 - Calcium
	N5	1.5	0.5
	N6	11.7	0.5
	N7	9.5	0.8
	N8	16.0	0.3
	EG 1	2.3	15.0
	EG 2	1.2	20.0

B.G. Identification

N1	Quartz, chlorite, epidote, pyrite, chalcopyrite, malachite, and native copper.
N2	Basalt (?) with chlorite, quartz, epidote, plagioclase, and native copper.
N3	Basalt porphory with chlorite, plagioclase, epidote, quartz, malachite, chalcopyrite, native copper and tenorite.

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ANALYST & WORK DONE

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ANALYST & WORK DONE

APPROVED:

LABORATORY SUPERVISOR

NOTE: Samples discarded after 60 days and pulps after 6 months unless instructed otherwise.

MOORE BUSINESS FORMS, INC. M

DM-11
Rev. 10/67

3.

Report No. 5192

Date of Report December 18, 1973

STATE OF ALASKA
Department of Natural Resources
DIVISION OF MINES AND GEOLOGY
Box College, Alaska 99701

LABORATORY ANALYSIS REPORT

For R. W. Voss

Address

Number of Samples

Date Sample Received

Work Done: (for Analyst see below)
A. X-ray flourescence quant. ☐ semi-quant. ☐
B. X-ray diffraction ☐
C. Spectrographic quant. ☐ semi-quant. ☐
D. Spectroscopic ☐
E. Atomic absorption quant. ☐ semi-quant. ☐
F. Fire assay ☐
G. Microscopic examination ☐
H. Other (Specify) ☐
I. Ultraviolet light ☐

LABORATORY NUMBER	SAMPLE MARKED	ANALYSIS OR IDENTIFICATION
		B.G. Identification
	N4	Breccia containing some jasper recemented by calcite-siderite and slightly serpentinized probably accounting for the increased nickel content.
	N5	Rocks are calcite with some quartz, malachite and azurite and 2, serpentinized breccia containing some pyrite. No sphalerite detected microscopically. Zinc may be present as a sulfate or carbonate.
	N6	Basalt with chlorite, epidote, plagioclase, quartz, chalcopyrite, pyrite, calcite and some malachite, Tennorite (or cuprite). Chalcopyrite is hydrothermal deposition with some dissemination into the basalt.
	N7	Basalt with chalcopyrite, malachite, and pyrite.
	N8	Quartz with arsenopyrite, pyrite, and chalcopyrite.
	EG 1	Calcite, quartz, chlorite, plagioclase, etc. similar to EG 2.
	EG 2	Calcite, chlorite, quartz, plagioclase, malachite, chalcopyrite, native copper and a trace of cuprite (or tennorite) Zinc mineralization may possibly be a tan sphalerite.

con't

ANALYST & WORK DONE

ANALYST & WORK DONE

ANALYST & WORK DONE

APPROVED.
LABORATORY SUPERVISOR

NOTE: Samples discarded after 60 days and pulps after 6 months unless instructed otherwise.

MOORE BUSINESS FORMS, INC. M

DM-11
Rev. 10/67

4.

Report No. 3192

Date of Report December 18, 1973

STATE OF ALASKA
Department of Natural Resources
DIVISION OF MINES AND GEOLOGY
College, Alaska 99701

LABORATORY ANALYSIS REPORT

For R. W. Voss

Address

Number of Samples

Date Sample Received

Work Done: (for Analyst see below)

A. X-ray flourescence quant. ☐ semi-quant. ☐
B. X-ray diffraction ☒
C. Spectrographic quant. ☐ semi-quant. ☐
D. Spectroscopic ☐
E. Atomic absorption quant. ☐ semi-quant. ☒
F. Fire assay ☐
G. Microscopic examination ☒
H. Other (Specify) ☐
I. Ultraviolet light ☐

LABORATORY NUMBER	SAMPLE MARKED	ANALYSIS OR IDENTIFICATION
		E. Nil gold means less than 0.001 troy ounces per ton. Accuracy of the atomic absorption analysis for gold, silver, copper, lead, and zinc is ±10% of the reported value.

E.G.B. Donald R. Stein Donald R. Stein
ANALYST & WORK DONE

ANALYST & WORK DONE

ANALYST & WORK DONE

APPROVED:
LABORATORY SUPERVISOR

NOTE: Samples discarded after 60 days and pulps after 6 months unless instructed otherwise.

MOORE BUSINESS FORMS, INC. M

Reed Engineering

1140 N. Lemon Street, Orange, California 92667

SPECTROGRAPHIC ANALYSIS

*Elements not detectable below .005%

For:

Date: JUN 30 1973

Sample No. #3

Film No. 03

Tests Recommended: Copper

	Approximate Values		
	Lbs. per ton	Value per ton	Percent
Aluminum	40	.40	2.0
Antimony			
Barium	---	---	trace
Beryllium			
Bismuth			
Cadmium			
Calcium	42	.42	2.1
Cesium			
Chromium	---	---	trace
Cobalt			
Columbium			
Copper	10	$5.00	.5
Fluorine			
Gallium			
Gold*			
Hafnium			
Indium			
Iridium*			
Iron	72	.86	3.6
Lead	---	---	trace
Lithium	---	---	trace
Magnesium	16	---	.08
Manganese			
Mercury			
Molybdenum			
Nickel			
Osmium*			
Palladium*			
Platinum*			
Potassium	10	.20	.5
Rhodium*			
Rubidium*			
Ruthenium*			
Silver			
Sodium	8	.08	.4

QUALITATIVE

	Approximate Values		
	Lbs. per ton	Value per ton	Percent
Strontium	.02	---	.001
Tantalum			
Thallium			
Thorium			
Tin			
Titanium			
Tungsten			
Vanadium			
Zinc			
Zirconium			

RARE EARTHS: none

	Lbs. per ton	Value per ton	Percent
Cerium			
Dysprosium			
Erbium			
Europium			
Gadolinium			
Holmium			
Lanthanium			
Lutetium			
Neodymium			
Praseodymium			
Samarium			
Terbium			
Thulium			
Ytterbium			
Yttrium			

Silicon, Water, Gases-------- 90.8 Percent

RADIOMETRIC ASSAY

(e) Uranium Oxide 0.0 Percent

Reed Engineering

1140 N. Lemon Street, Orange, California 92667

SPECTROGRAPHIC ANALYSIS

*Elements not detectable below .005%

For:

Date: JUN 30 1973

Sample No. #4

Film No. 04

Tests Recommended: Copper

Mr. R. J. Voss
PO Box 147
Elmendorf AFB, Al.
99506

	Approximate Values Lbs. per ton	Value per ton	Percent
Aluminum	30	.30	1.5
Antimony			
Barium			
Beryllium			
Bismuth			
Cadmium			
Calcium	64	.64	3.2
Cesium			
Chromium			
Cobalt			
Columbium			
Copper	16	$8.00	.8
Fluorine			
Gallium			
Gold*			
Hafnium			
Indium			
Iridium*			
Iron	68	.80	3.4
Lead			
Lithium	---	---	trace
Magnesium	8	.04	.4
Manganese			
Mercury			
Molybdenum			
Nickel			
Osmium*			
Palladium*			
Platinum*			
Potassium	22	.44	1.1
Rhodium*			
Rubidium*			
Ruthenium*			
Silver			
Sodium	14	.14	.7

QUALITATIVE

	Approximate Values Lbs. per ton	Value per ton	Percent
Strontium	.1	---	.05
Tantalum			
Thallium			
Thorium			
Tin			
Titanium	.06	---	.003
Tungsten			
Vanadium			
Zinc			
Zirconium			

RARE EARTHS : none

	Lbs. per ton	Value per ton	Percent
Cerium			
Dysprosium			
Erbium			
Europium			
Gadolinium			
Holmium			
Lanthanium			
Lutetium			
Neodymium			
Praseodymium			
Samarium			
Terbium			
Thulium			
Ytterbium			
Yttrium			

Silicon, Water, Gases--------88.8 Percent

RADIOMETRIC ASSAY

(e) Uranium Oxide 0.0 Percent

Reed Engineering

1140 N. Lemon Street, Orange, California 92667

SPECTROGRAPHIC ANALYSIS

*Elements not detectable below .005%

For:

Date: JUN 30 1973

Sample No. #18

Film No. 18

Tests Recommended: Copper

	Approximate Values Lbs. per ton	Value per ton	Percent
Aluminum	28	.28	1.4
Antimony			
Barium			
Beryllium			
Bismuth			
Cadmium			
Calcium	42	.42	2.1
Cesium			
Chromium	.8	---	.04
Cobalt			
Columbium			
Copper	48	$24.00	2.4
Fluorine			
Gallium			
Gold*			
Hafnium			
Indium			
Iridium*			
Iron	270	$3.04	13.5
Lead	2	.40	.1
Lithium	---	---	trace
Magnesium	50	.25	2.5
Manganese	.6	---	.03
Mercury			
Molybdenum			
Nickel			
Osmium*			
Palladium*			
Platinum*			
Potassium	12	.24	.6
Rhodium*			
Rubidium*			
Ruthenium*			
Silver			
Sodium	160	$1.60	8.0

QUALITATIVE

	Approximate Values Lbs. per ton	Value per ton	Percent
Strontium	2	.06	.1
Tantalum			
Thallium			
Thorium			
Tin			
Titanium	2	.20	.1
Tungsten			
Vanadium			
Zinc			
Zirconium			

RARE EARTHS : none

	Lbs. per ton	Value per ton	Percent
Cerium			
Dysprosium			
Erbium			
Europium			
Gadolinium			
Holmium			
Lanthanium			
Lutetium			
Neodymium			
Praseodymium			
Samarium			
Terbium			
Thulium			
Ytterbium			
Yttrium			

Silicon, Water, Gases--------69.1 Percent

RADIOMETRIC ASSAY

(e) Uranium Oxide 0.0 Percent

ALASKA

MINERAL LAB

~~XXXXXXXXXXXXXXXX~~ 702 W. 32nd Avenue
ANCHORAGE, ALASKA 99503
PHONE 272-2716

REPORT OF ANALYSIS

DATE July 5, 1973

FOR R. W. Voss
SRA Box 1450-A
Anchorage, Alaska 99502

PAGE 1 OF 1

LAB. NO.	IDENT. NO.	DESCRIPTION	ELEMENT / UNIT				
0067	LG-18	Pulverized rock sample	Cu	1.10	%		

COMMENTS:

BY Susan A. Dechant

TITLE Susan A. Dechant, Lab Manager

ALASKA

MINERAL LAB

~~1229 SPENARD ROAD~~ 702 W. 32nd Avenue
ANCHORAGE, ALASKA 99503
PHONE 272-2716

REPORT OF ANALYSIS

FOR Ray Voss DATE July 11, 1973

PAGE 1 OF 1

LAB. NO.	IDENT. NO.	DESCRIPTION	ELEMENT / UNIT				
9072	46-4	Chalcopyrite in quartzite matrix		Cu	0.739	%	

COMMENTS:

BY Susan A. Dechant

TITLE Susan A. Dechant, Lab Manager

ALASKA

MINERAL LAB

~~2229 S. PENNARD ROAD~~ 702 W. 32nd Avenue
ANCHORAGE, ALASKA 99503
PHONE 272-2716

REPORT OF ANALYSIS

FOR Ray Voss DATE August 6, 1973

PAGE 1 OF 1

LAB. NO.	IDENT. NO.	DESCRIPTION	ELEMENT / UNIT				
9968	LM1-2	Pulverized rock sample		Cu	1.128	%	

COMMENTS:

BY Susan A. Dechant

TITLE Susan A. Dechant, Lab Manager

C5

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

P.O. BOX 4-1276 ANCHORAGE, ALASKA 99509 2603 ARCTIC BLVD. TELEPHONE (907)279-4014

GEOLOGICAL REPORT AND ANALYSES

OF SAMPLES FROM THE

HORSESHOE RIDGE AREA

ALASKA

Archie L. Green

ARCHIE L. GREEN,
Vice President

JANUARY, 1974

C O N T E N T S

INTRODUCTION. 1

RECOMMENDATIONS. 3

ANALYTICAL REPORTS. 4

SAMPLE DESCRIPTIONS. 10

ESTIMATED COSTS. 15

In December 1973, Mr. Ray Voss, Northern Lights Exploration, Inc. presented to Chemical & Geological Laboratories of Alaska, Inc. various samples for analysis from the Horseshoe Ridge and Shotgun Creek areas.

The purpose of this investigation was to establish a systematic exploration and evaluation program for the claims held by Northern Lights Exploration, Inc.

The samples were analyzed for Copper, Zinc, Nickel, Gold, Lead, Silver and Arsenic. Locations, concentrations and approximate fault zones were plotted on overlays.

Visual descriptions by binocular microscope were made from the samples submitted. See sample descriptions page 10 *

Indications are that the mineralization in the rock has occurred in fractures by hydrothermal activity. This is evidenced by the gangue minerals being deposited over slickenslides.

Although samples were scattered, analysis indicated some concentrations as high as 2.4% Copper. These random samples can be grouped into three (3) general classifications. Stream samples (C-1 through C-7) were taken from lower Shotgun Creek, Soil samples (J-1 through J-9) were taken from the slope area south of Ohio Creek and outcrops and talus samples (1-5 and 9-13) along the Chulitna Fault Zone.

*Samples 1-5 were initial samples analyzed and no description was recorded.

Analysis shows Copper and Nickel most prominent in the stream samples with Copper varying from 65 to 100 ppm and Nickel 100 to 173 ppm. (See Analytical Report #page 5. Sample C-3 showed a substantial increase in Zinc (146 ppm) and Arsenic (266 ppm) over the other samples in this category. In addition to C-3, sample C-5 also had an Arsenic content of 266 ppm.

This sample was unlike other stream samples as the fine material had not been washed away. It appears that there has been a high degree of weathering, as the pebbles are moderately soft and have a vugular appearance indicating that leaching has taken place.

Soil sample analysis indicates minerals tested for were present in some degree, however sample J-3 was substantially higher in Zinc (146 ppm) and J-8 higher in Nickel (115 ppm).

Outcrop and talus samples 1-5 and 9-13 were analyzed and results listed in analytical reports pages 4 and 9 . These results show that three (3) samples had significant amounts of Copper. Sample #1 from Horseshoe Ridge had as high as 2.4% while samples Upper #9 and No. 12 had 1.14% and 1.34% respectfully. Zinc was present in No. 10, 11 and 12 in amounts greater than 120 ppm with No. 10 having 120 ppm, No. 11, 150 ppm and No. 12, 130 ppm.

Interpretation of analysis show that further exploration, sampling and mapping should be preformed with emphasis placed on areas of Horseshoe Ridge and the Fissure Vein located southwest of Horseshoe Ridge on the Chulitna Fault Zone. With the results of these studies we present the following recommendations.

RECOMMENDATIONS

(1) Obtain Aeromagnetic maps of the area from the State of Alaska.

(2) Map the geology of the Upper Chulitna Fault Zone with particular attention given to the area between the "Fissure Vein" and "Horseshoe Ridge".

(3) Define potential drilling targets in this area. Considerable field sampling, core sampling and surveying may be entailed.

(4) Begin a stream sediment sampling program at the junction of Shotgun Creek and Ohio Creek. Take samples every one thousand (1,000) feet upstream to the glaciers. This would include Shotgun, Little Shotgun, No Name Creek and all drainages.

(5) Ground Em or Ground Magnotometer survey should be accomplished in conjunction with the above mapping and sampling program.

(6) The geology of the entire claim area held by Northern Lights Exploration, Inc. should be sampled and mapped.

(7) This property appears to be economically viable. A program to establish reserves should be initiated.

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

TELEPHONE (907) 279-4014 P.O. BOX 4-1276 2603 ARCTIC BLVD.

ANCHORAGE, ALASKA 99509

ANALYTICAL REPORT

Company NORTHERN LIGHTS EXPLORATION, INC. Type of sample ROCK

Address Anchorage, Alaska Date December, 1973 Lab. No.

Other Pertinent Data

Analytical method ATOMIC ABSORPTION Analytical classification

Sample			COPPER	SILVER	NICKEL	GOLD	ZINC
1 UPPER #9							
2 ppm			11400	4	40	10	90
3 Oz/Ton			372.4				
4 %/Wt.			1.14				
5							
6 LOWER #9							
7 ppm			7500	4	70	50	50
8 Oz/Ton			245.0				
9 %/Wt.			0.75				
10							
11 #10							
12 ppm			810	1	40	1	120
13 Oz/Ton			26.5				
14 %/Wt			0.08				
15							
16 #11							
17 ppm			8450	20	30	1	150
18 Oz/Ton			276.1				
19 %/Wt.			0.84				
20							
21 #12							
22 ppm			13400	10	60	18	130
23 Oz/Ton			437.8				
24 %/Wt.			1.34				
25							
26 #13							
27 ppm			710	4	20	1	55
28 Oz/Ton			23.2				
29 %/Wt.			0.07				
30							
Threshold							

ND - Not detected

Remarks

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

TELEPHONE (907) 279-4014 P.O. BOX 4-1276 2603 ARCTIC BLVD.

ANCHORAGE, ALASKA 99509

ANALYTICAL REPORT

Company NORTHERN LIGHTS EXPLORATION, INC. Type of sample ROCK

Address Anchorage, Alaska Date December 31, 1973 Lab. No.

Other Pertinent Data

Analytical method ATOMIC ABSORPTION Analytical classification

Results in parts/million

Sample	COPPER	NICKEL	ZINC	SILVER	GOLD	LEAD	ARSENIC
1 J-1	60	48	93	3	06	29	ND
2 J-2	60	96	78	ND	0.7	41	ND
3 J-3	95	38	146	ND	0.7	33	ND
4 J-4	54	52	87	2	0.6	40	ND
5 J-5	57	57	36	1	0.5	29	ND
6 J-6	62	57	86	3	0.7	35	ND
7 J-7	60	48	87	2	0.7	36	ND
8 J-8	64	115	93	2	0.6	36	ND
9 J-9	55	57	83	2	0.5	45	ND
10							
11							
12 C-1	101	173	83	2	0.4	55	ND
13 C-2	110	173	88	1	0.5	20	ND
14 C-3	65	120	146	3	0.5	28	266
15 C-4	96	134	98	3	0.4	33	ND
16 C-5	69	100	90	2	0.6	18	266
17 C-6A	87	139	89	3	0.5	10	ND
18 C-6	82	134	89	2	0.7	32	ND
19 C-7	81	163	98	4	0.5	17	ND
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
Threshold							

ND - Not detected

Remarks

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

TELEPHONE (907) 279-4014 P.O. BOX 4-1276 2603 ARCTIC BLVD.

ANCHORAGE, ALASKA 99509

ANALYTICAL REPORT

Company NORTHERN LIGHTS EXPLORATION, INC. Type of sample MINERALS

Address Anchorage, Alaska Date December 5, 1973 Lab. No. 1346-1

Other Pertinent Data

Analytical method Atomic Absorption Analytical classification

TALUS SAMPLE

Sample		ACID IN-SOLUBLE-%	COPPER	IRON	GOLD	SILVER	LEAD
1		4.14					
2 Parts/million			5655	394,544	<0.1	26	55
3							
4 % by Weight			0.57	39.5	<0.1	0.003	0.006
5							
6 Oz/Ton			185	12,890	<0.003	0.84	1.80
7							
8							
9							
10							
11							
12							
13							
14							
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26							
27							
28							
29							
30							
Threshold							

ND - Not detected

Remarks

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

TELEPHONE (907) 279-4014 P.O. BOX 4-1276 2603 ARCTIC BLVD.

ANCHORAGE, ALASKA 99509

ANALYTICAL REPORT

Company NORTHERN LIGHTS EXPLORATION, INC. Type of sample MINERAL

Address Anchorage, Alaska Date December 5, 1973 Lab. No. 1346-2

Other Pertinent Data

Analytical method Atomic Absorption Analytical classification

COBBLE SAMPLE

Sample		ACID IN-SOLUBLES-%	COPPER	IRON	GOLD	SILVER	LEAD
1		34.70					
2	Parts/million		8225	109,745	<0.1	<0.1	1833
3							
4	% by Weight		0.82	10.97	<0.1	<0.1	0.18
5							
6	Oz/Ton		269	3,585	<0.003	<0.003	60
7							
8							
9							
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26							
27							
28							
29							
30							
Threshold							

ND - Not detected

Remarks

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

TELEPHONE (907) 279-4014 P.O. BOX 4-1276 2603 ARCTIC BLVD.

ANCHORAGE, ALASKA 99509

ANALYTICAL REPORT

Company NORTHERN LIGHTS EXPLORATION INC. Type of sample MINERALS

Address Anchorage, Alaska Date December 5, 1973 Lab. No. 1346-3

Other Pertinent Data

Analytical method Atomic Absorption Analytical classification

		COPPER
Sample #1		
1	Parts per million	1049
2		
3	Percent by weight	0.10
4		
5	Ounces/per ton	34
6		
7		
8		
9	Sample #2	
10		
11	Parts per million	7012
12		
13	Percent by weight	0.70
14		
15	Ounces per ton	229
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
Threshold		

ND - Not detected

Remarks #1 Large outcrop left of pup stream just below red on ridge.
#2 Another large outcrop (Same area)

S A M P L E

(1) Horseshoe Ridge, in place materials, see slide.

Reed #3 (6/30/73)	.5% cu	3.6% fe
Reed #4 (6/30/73)	.8% cu	3.4% fe
Reed #18(6/30/73).	.2.4% cu	13.5% fe
Mineral Lab #9067 (7/5/73). . .	1.1% cu	not tested
Mineral Lab #9072 (7/11/73). .	.739% cu	not tested

(2) Chem. Geo. Lab #1346-1 (12/5/73) . . .57% cu . . . . 39.5% fe
(Talus sample Shotgun Creek) (Fissure)

(3) Chem. Geo. Lab #1346-2 (12/5/73). . .82% cu. . . . 10.97% fe
(Cobble, Shotgun Creek)(Fissure).

SHOTGUN CREEK ridge, inplace materials.

(4) Chem. Geo. Lab #1346-3-1 (12/5/73) .1% cu . . . not tested
(Below red bed) (Northside of fissure)

(5) Chem. Geo. Lab #1346-3-2 (12/5/73) .7% cu. . . . not tested
(Large outcrop northside of fissure).

OUTCROP & TALUS SAMPLES

Upper 9	Fractured basalt. Some quartz with chalcopyrite, bornite, malachite, pyrite, chrysocolla and iron oxide.
No. 9	Basalt partially serpentinized with pyrite, chalcopyrite, malachite and chrysocolla.
No. 10	Black carbonaceous shale shows pyrite, chalcopyrite, iron oxide.
No. 11	Float sample from Shotgun Creek. From quartz vein, iron oxide coating over quartz, pyrite, chalcopyrite, bornite, marcasite and calcite.
No. 12	Serpentinite with malachite, chrysocolla, iron oxide and chalcopyrite.
No. 13	Serpentinite with malachite and chrysocolla.

SOIL SAMPLES

J - 1 (4,000') 700' up side of mt on Ohio above last bench.

Silt, brown sandy, dirty, soft, very humus, iron staining, occassional metamorphic pebble, trace of small magnetic siltstone aggregates.

J - 2 2500' by 7500' from camp, side hill no vegetation except grass.

Silt, brown, sandy, iron stained, slightly conglomeratic, pebbles and granules are weathered metamorphics and brownish-red ironstone, trace magnetic.

J - 3 4500' open hill side below large outcrop on large mt on Ohio, stream bank.

Sand, brown, very fine, iron stained, very silty, dirty, humus, igneous (basalt ?) and metamorphic pebbles and granules common, partly weathered, occassional pebble with slight reddish-brown iron stain coating, non-magnetic.

J - 4 2000' very base next to last bench before big mt on Ohio. Small stream adjacent.

Silt, brown, sandy, dirty, iron stained, humus, highly weathered, iron stained metamorphic pebbles common, some pebbles display fracture surfaces, non-magnetic.

J - 5 2300' below outcrop on first bench before large mt on Ohio. Stream bank.

Sand, gray-brown, very fine grained, silty, carbonaceous, micaeous, iron stained, occassional metamorphic pebbles.

J - 6 900' rolling hills, mountains northwest, side of bank under outcrop.

Gravel, varicolored pebbles with light brown clay and silt matrix. Pebbles are igneous and metamorphic, partly highly weathered and highly iron stained, occassional ironstone pebbles. Some pebbles display fracture surfaces.

J - 7 600' up Ohio from camp site. Dug into side of bank.

Silt, light brown, sandy, dirty, humus, iron stained, occassional metamorphic pebbles, one small aggregate of light gray-green pellets, possibly copper or nickel.

J - 8 Top of mt in lower stream 1500' south of Ohio, 4000' down Ohio. Stream bed.

Silt, light brown, sandy, dirty, slightly humus, occassional metamorphic and ironstone pebbles.

J - 9 3500' rolling hill, last bench before large mt on Ohio, side of mt 3500' from camp.

Sand, light brown, very fine grained, very silty, dirty, occassional plant remains, iron staining, ironstone and metamorphic pebbles, occassional magnetic grain.

STREAM SEDIMENT SAMPLES

C - 1 150' from mouth of Shotgun Cr., north side, old stream bed.

Gravel, predominately metamorphic and igneous pebbles, some brown-red ironstone, trace dark green, highly metamorphozed rock, possibly serpentinized or chloritic.

C - 2 1000' from mouth, same as others, about 1/2 mi. from hills.

Sand, coarse to very coarse, pebbles common, varicolored grains, metamorphic, igneous and red shale grains and granules, some ironstone pebbles and grains, rare grains with dark green coating, rare bright green crystal, instatite?

C - 3 500' west of Shotgun Cr., 3000' from mouth, 200' above stream bed, taken from 2' inside of squirrel hole.

Gravel, yellow-brown, very silty, sandy and dirty, highly iron stained, pebbles highly weathered and moderately soft, leaching common.

C - 4 1300' from mouth, a lot of green and red rock in area, stream bed.

Sand, varicolored, coarse grained with occassional pebbles, dark and light metamorphic and igneous grains, red shale grains common, magnetic grains moderately common, green instatite? crystals present.

C - 5 2500' from mouth, west side Shotgun Cr., willows and overburdon, 100' west side of S. G. Cr. from a small stream against hill.

Gravel, sandy, predominately dark igneous pebbles and grains, occassional red shale pebbles.

C - 6 1800' from mouth, green and red float rock, a little quartz, stream bed.

Sand, varicolored, occassional pebbles, green crystals common, occassional magnetite grain.

C - 6 A 600' from mouth of Shotgun, same as Test #1, stream bed.

Gravel with clayey, silty sandstone matrix, large conglomeratic pebble, highly fractured, plant remains.

C - 7 700' from mouth, Cr. bed, taken from sharp curve in Creek.

Sand, varicolored, medium to very coarse grained green crystals common, red shale grains, very dark gray to black argillite grains and granules with pyrite crystals, plant remains, occassional magnetic grains, large metamorphozed pebble with iron staining, pyritic.

E X P L O R A T I O N

E S T I M A T E D C O S T S

Operator (Northern Lights Exploration, Inc.) to provide lodging, meals and transportation of equipment and personnel between Anchorage to and around claim area.

Two (2) geologist in field, mapping, sampling, geochemical and geophysical data accumulation.

Estimated cost 40 days at $400.00 per day. . . . $16,000.00

Analytical work (Au, Ag, Pb, An, As, Pt, Cu) or others in addition or as indicated.

Estimated cost. . . . . $ 5,000.00

Two (2) geologist and/or engineers in laboratory, final mapping, reports and evaluation.

Estimated cost 16 days at $250.00 per day. . . . $ 4,000.00

Total Estimated Costs. $25,000.00

EXPLORATION

ESTIMATED COSTS

Contractor to furnish all personnel, equipment and supplies.

Two (2) geologists in field, mapping, sampling, geochemical and geophysical detailing.

Estimated cost 50 days at $400.00 per day. . . . $20,000.00

Drilling program.

Estimated cost 40 days. $30,000.00

Drilling materials, core barrel, bits, overshot etc.

Estimated cost. . . . . $ 6,000.00

Analytical work (Au, Ag, Pb, Zn, As, Pt, Cu) and/or others in addition or as indicated.

Estimated cost. $10,000.00

Tent camp, cook, sleeping etc.

Estimated cost. . . . . $ 8,000.00

Jet Ranger 206 B

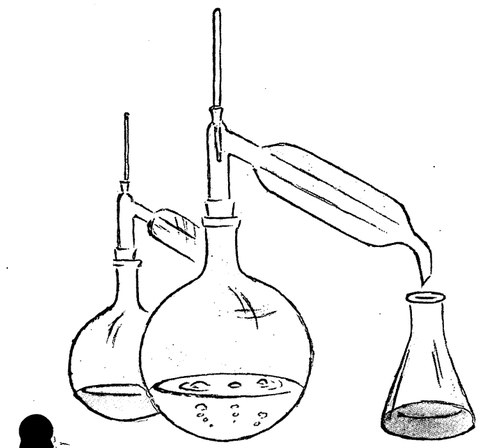
Estimated cost 100 hours. $24,000.00

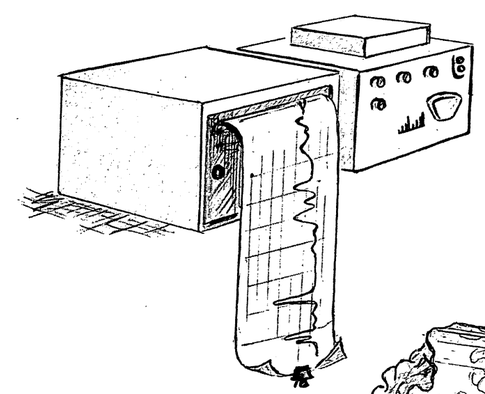
Two (2) geologists and/or engineers, in laboratory final mapping, reports and evaluation.

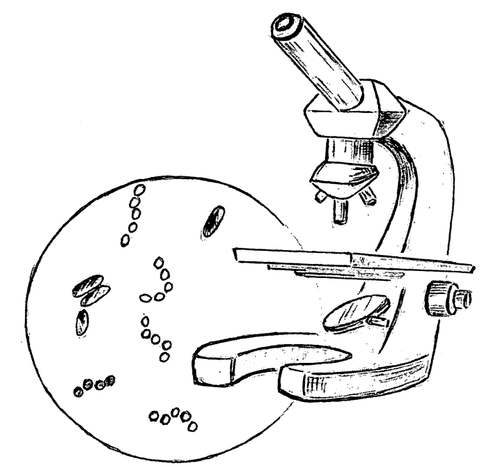
Estimated cost 30 days at $250.00 per day. . . .$ 7,500.00

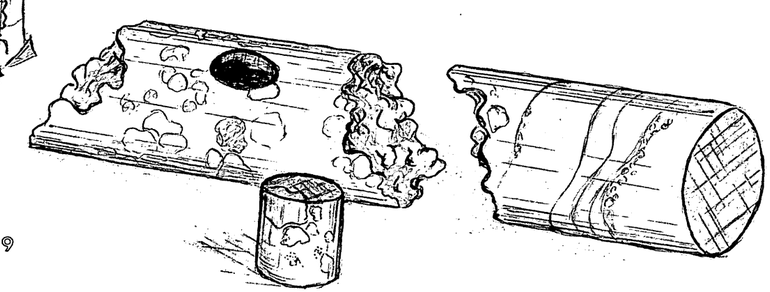
Total Estimated Cost. $106,600.00

Chemical & Geological Laboratories of Alaska, Inc.









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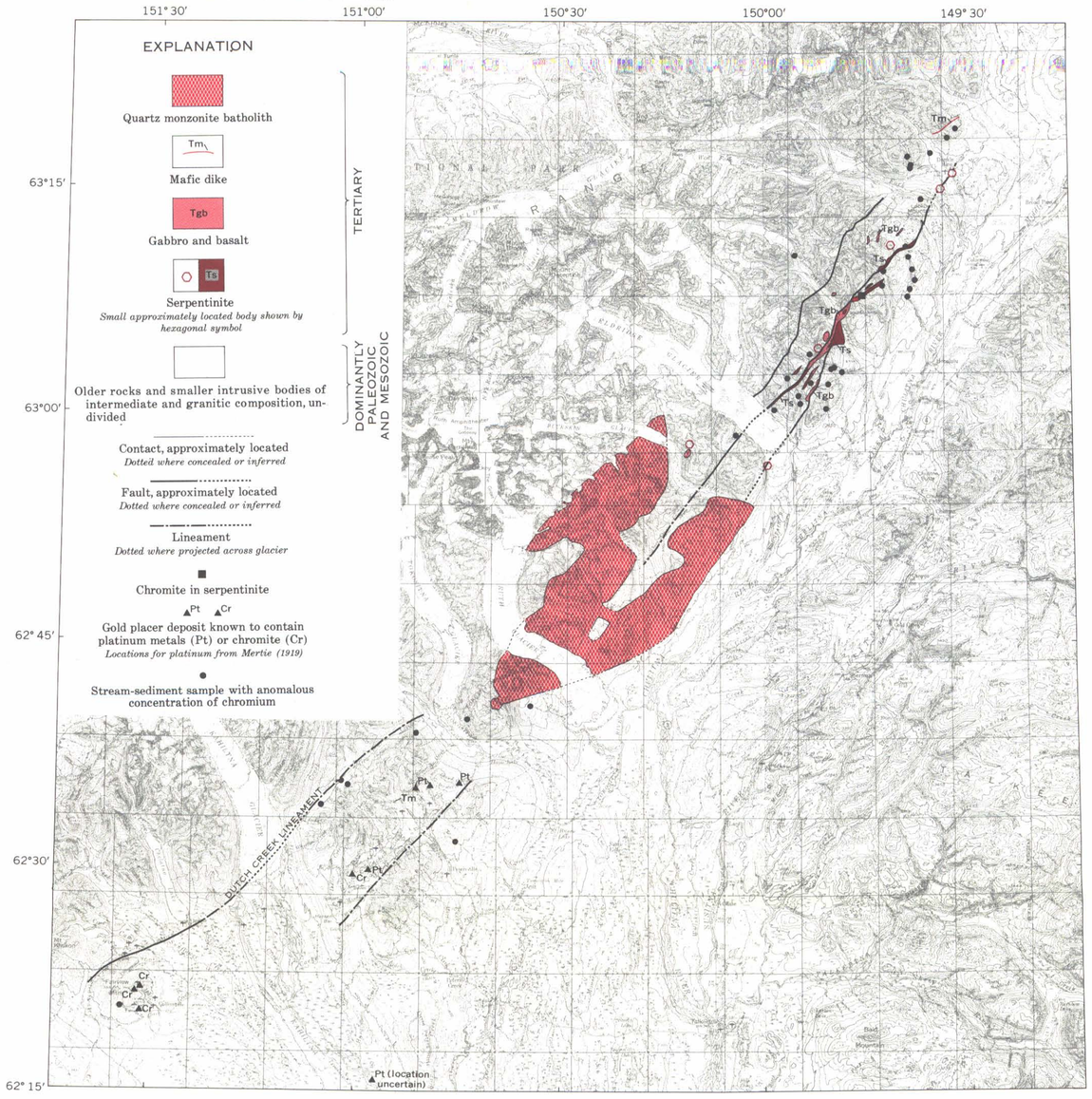
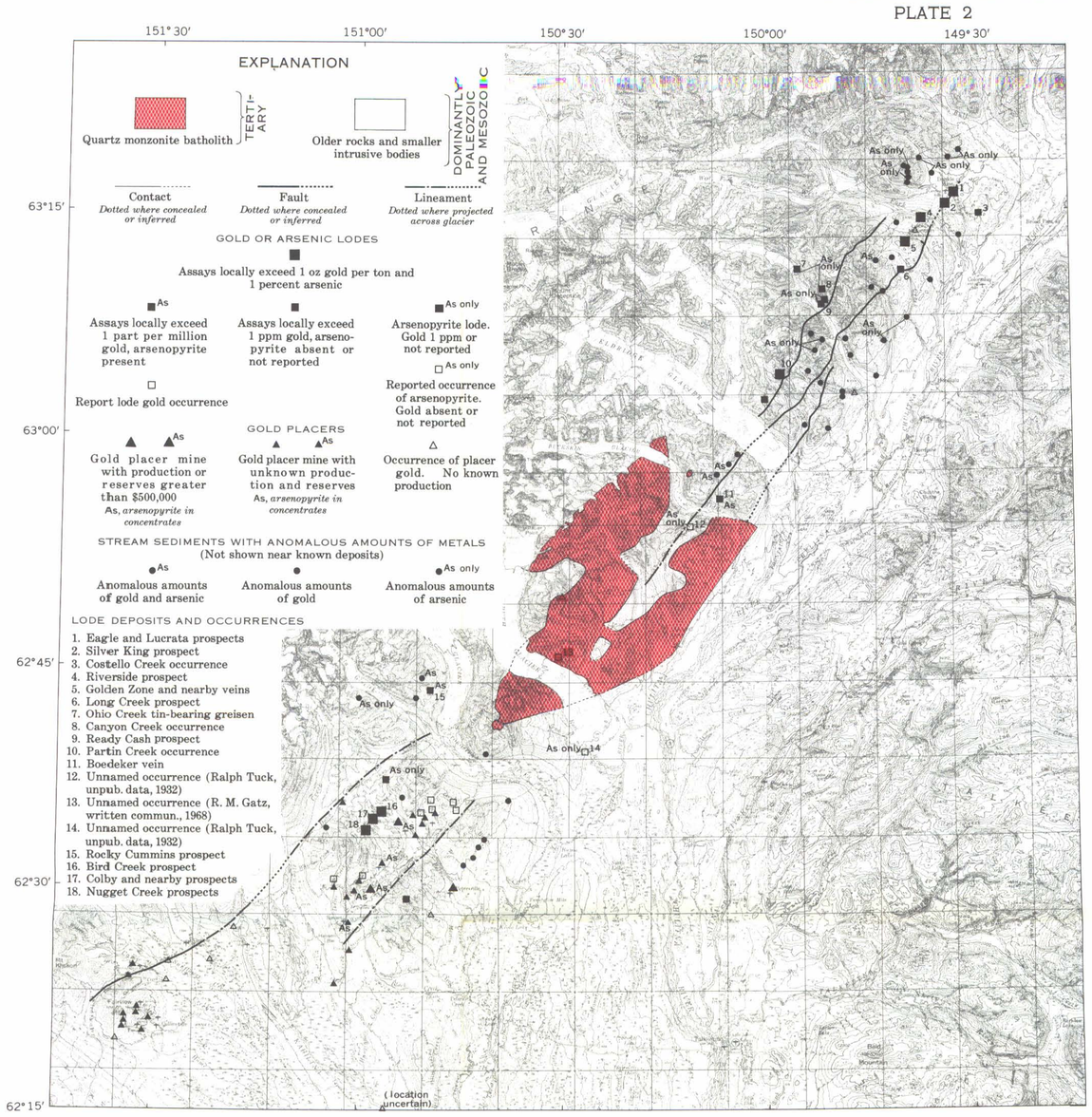
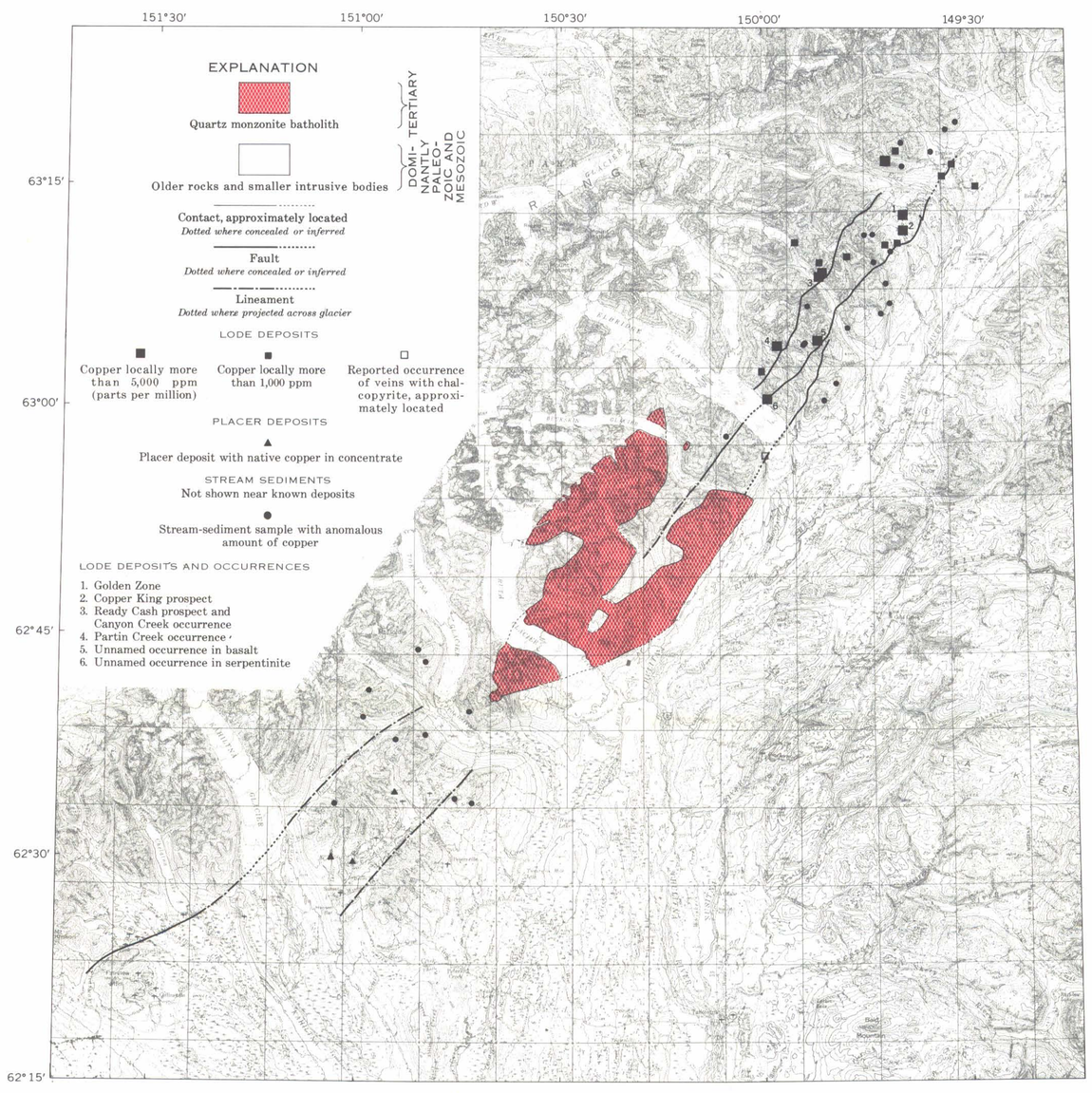
Serpentinite
Serpentinite
fault
fault
fault
fault
Chulitna
upper fault
State Prospecting sites
Christy
Creek
McCallie
Creek
Copeland
Creek
Ohio
Creek
Shotgun
Creek
Shotgun
Creek
Coal
Creek
Eldridge Glacier
VABM 5048 Copeland
RED BEDS
Red Beds
Red Beds
REDBEDS
GABBRO & BASALT
INTERLAYERED LIMESTONE & BASALT
HORSESHOE RIDGE
NO NAME STREAM
GLACIER
FLOAT
TALUS
Soil Samples
RC STREAM SAMPLES
ARGILLITE
Siliceous argillite and interlayered red graywacke
INTERLAYERED RED GRAYWACKE ARGILLITE
FAULT



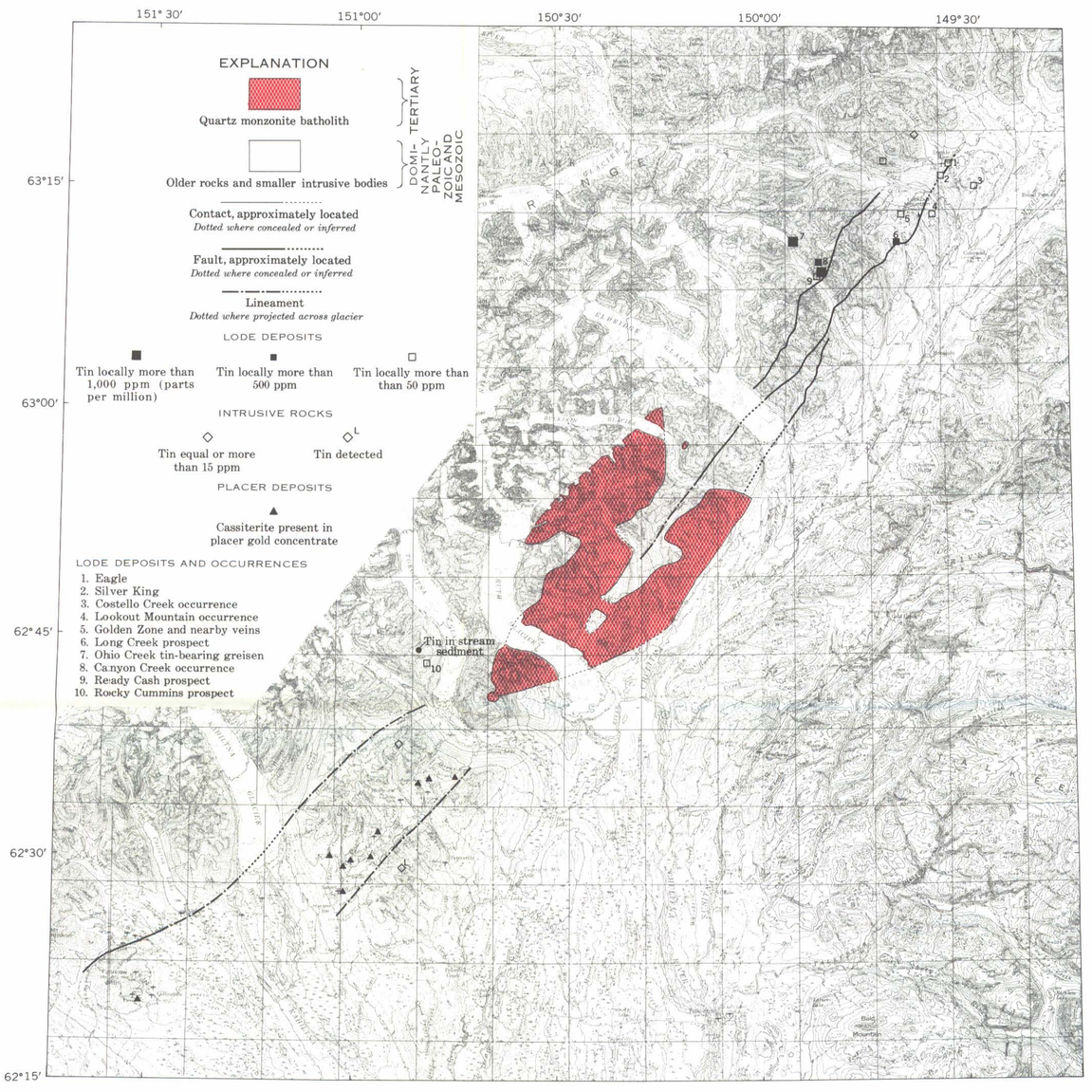
MAFIC AND ULTRAMAFIC ROCKS, PLATINUM, AND CHROMIUM



GOLD AND ARSENIC



COPPER



TIN

Base from U.S. Geological Survey 1:250,000 Topographic Series: Healy, 1956; Mt. McKinley, 1958; Talkeetna Mountains, 1954; Talkeetna, 1958, Alaska

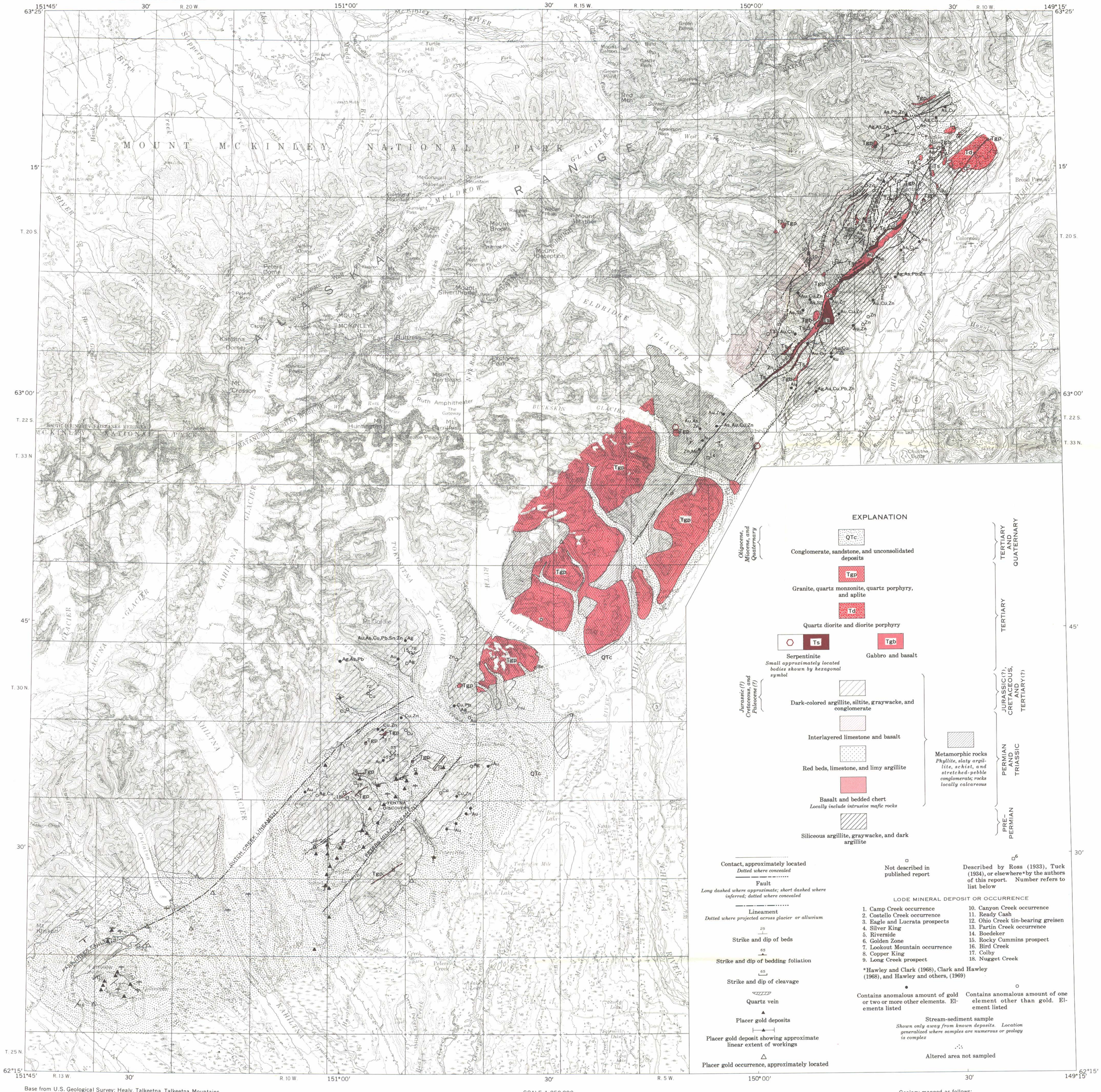
SCALE 1:500 000

10 0 10 20 30 MILES

10 0 10 20 30 KILOMETERS

MAPS SHOWING DISTRIBUTION OF METALS AND MAFIC AND ULTRAMAFIC ROCKS IN THE CHULITNA-YENTNA MINERAL BELT, ALASKA

* U.S. GOVERNMENT PRINTING OFFICE: 1973—515-658/48



Base from U.S. Geological Survey: Healy, Talkeetna, Talkeetna Mountains, and Mount McKinley 1:250,000 quadrangles

SCALE 1:250 000

5 0 5 10 15 MILES

5 0 5 10 15 KILOMETERS

CONTOUR INTERVAL 200 FEET
DATUM IS MEAN SEA LEVEL

Geology mapped as follows:
Upper Chulitna district by C. C. Hawley, A. L. Clark, M. H. Herdrick, and S. H. B. Clark, 1967–68;
Curry district by Ralph Tuck, 1934, and reconnaissance mapping by A. L. Clark, S. H. B. Clark, and C. C. Hawley, 1968;
Yentna district, combined Tertiary and Quaternary unit and Collinsville area after Barnes (1966). Peters Hills and Dutch Hills by A. L. Clark and C. C. Hawley, 1967–68

GENERALIZED GEOLOGIC MAP SHOWING MINERAL DEPOSITS OF THE CHULITNA-YENTNA MINERAL BELT, ALASKA

* U.S. GOVERNMENT PRINTING OFFICE: 1973—515-658/46