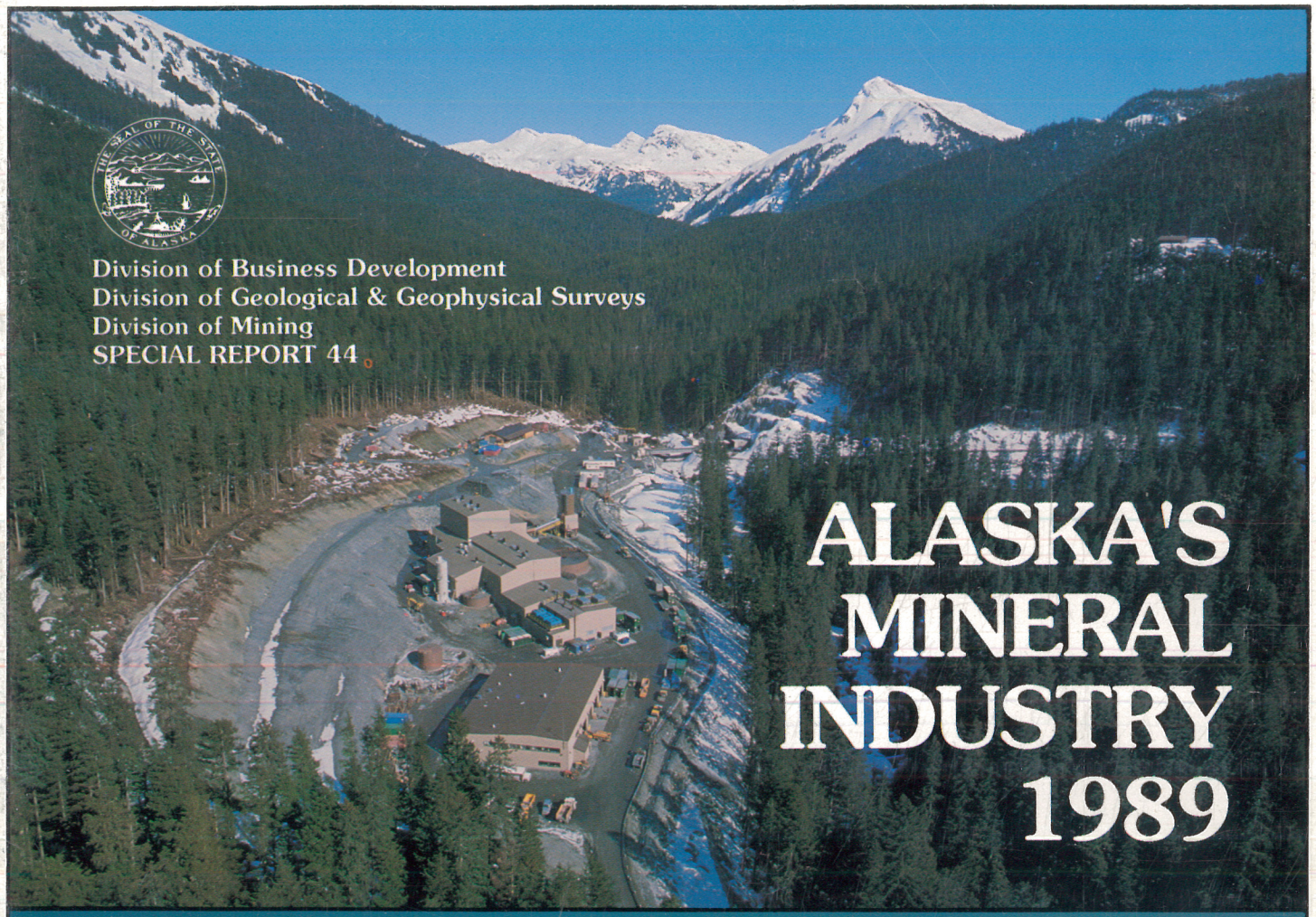


Division of Business Development
Division of Geological & Geophysical Surveys
Division of Mining
SPECIAL REPORT 44

ALASKA'S MINERAL INDUSTRY 1989

Front cover: *Top--Aerial view of the Greens Creek Mining Company's mill and portal entrance on Admiralty Island in southeast Alaska. Located 18 miles from Juneau, this Kennecott Corporation operation, a subsidiary of RTZ Corporation, went into production in early 1989. Photograph courtesy of Greens Creek Mining Company.*

Bottom--The Red Dog mine, an operation of Cominco-Alaska Inc. on NANA Regional Corporation land went into production in 1989. This mine is located 90 miles north of Kotzebue in the De Long Mountains of northwest Alaska. Photograph courtesy of Cominco-Alaska Inc.

ALASKA'S MINERAL INDUSTRY, 1989

By T.K. Bundtzen, R.C. Swainbank, J.R. Deagen, and J.L. Moore

Division of Geological & Geophysical Surveys

SPECIAL REPORT 44

STATE OF ALASKA
Steve Cowper, *Governor*

Fairbanks, Alaska
1990

STATE OF ALASKA

DEPARTMENT OF COMMERCE AND ECONOMIC DEVELOPMENT

Larry Merculieff, *Commissioner*

Division of Business Development
James M. Parsons, *Director*

DEPARTMENT OF NATURAL RESOURCES

Lennie Gorsuch, *Commissioner*

Division of Geological and Geophysical Surveys
Robert B. Forbes, *Director and State Geologist*

Division of Mining
Gerald Gallagher, *Director*

Available from Alaska Division of Geological and Geophysical Surveys, 3700 Airport Way, Fairbanks, AK 99709-4699 and from U.S. Geological Survey Earth Science Information Centers, 4230 University Drive, Room 101, Anchorage, AK 99508 and 605 West 4th Avenue, Room G84, Anchorage, AK 99501. Mail orders should be addressed to the DGGS office in Fairbanks.

FOREWORD

Special Report 44, "Alaska's Mineral Industry - 1989," is the ninth annual report produced by the Department of Natural Resources, Division of Geological and Geophysical Surveys, the Division of Mining, and the Department of Commerce and Economic Development, Division of Business Development.

The primary objective of this report is to provide current, accurate and technically reliable information on Alaska's mineral industry. The report is dependent on the cooperation of private industry, individuals, and government agencies who provide information on their mining projects and activities.

In 1989, the sum of expenditures for exploration and development and the value of production totaled $459 million, a decrease of 17 percent from 1988. The decrease reflects the shift from development to production status at the Greens Creek and Red Dog mines. Overall value of mineral production increased from $232 million in 1988 to $277 million in 1989 and is attributed to production of metal concentrates from the Greens Creek mine near Juneau. Exploration expenditures also increased from $45.9 million in 1988 to $47.8 million in 1989.

Alaska's 1989 gold production of about 285,000 ounces was the highest in four decades although lower average bullion prices decreased the product value about 4 percent from 1988 levels. Production from the Red Dog mine will begin in 1990, and Alaska metal production is expected to be significantly greater in 1990 than in 1989.

We anticipate continued growth of mineral production and jobs through the 1990's.

Robert B. Forbes
Director and State Geologist
Division of Geological and Geophysical Surveys

James M. Parsons
Director
Division of Business Development

Gerald Gallagher
Director
Division of Mining

METRIC CONVERSION FACTORS

Factors for converting U.S. customary units to international metric units are as follows:

To convert from	To	Multiply by
	MASS	
ounce, troy (oz tr)	kilogram (kg)	0.0311
ounce, avoirdupois (oz avdp)	kilogram (kg)	0.0283
pound, avoirdupois (lb)	kilogram (kg)	0.4536
ton, short (2,000 lb)	tonne (Mg)	0.9072
tonne (Mg)	ton (2,000 lb)	1.102
	LENGTH	
foot (ft)	meter (m)	0.3048
mile (mi)	kilometer (km)	1.609
	AREA	
mile^2 (mi^2)	kilometer^2 (km^2)	2.590
acre	hectometer^2 (hm^2)	.4047
	VOLUME	
yard^3 (yd^3)	meter^3 (m^3)	0.7646
gallon	liter	3.785

CONTENTS

FIGURES

TABLES

ALASKA'S MINERAL INDUSTRY, 1989

By T.K. Bundtzen,[1] R.C. Swainbank,[2] J.R. Deagen,[3] and J.L. Moore[1]

EXECUTIVE SUMMARY

INTRODUCTION

Alaska's mineral industry experienced positive growth during 1989, especially in the hard-rock mining and exploration sectors, but suffered declines in mineral development expenditures, in sand-and-gravel, and in stone production. Exploration expenditures totaled $47.8 million in 1989 compared to $45.5 million in 1988. Overall value of mineral production, which increased 19 percent from $232 million in 1988 to $277 million in 1989 (table 1; fig. 1), is attributed mainly to production of metal concentrates from the Greens Creek mine near Juneau. Mineral development expenditures decreased substantially in 1989 to $134.3 million from an all-time high of $274.9 million in 1988. The decrease reflects the shift from development to production status within the large Greens Creek and Red Dog projects. Total value of Alaska's mineral industry in 1989, as measured by the sum of exploration, development expenditures, and mineral production, amounted to $459 million compared to $552.6 million in 1988, a decrease of about 17 percent because of the decline in development activities.

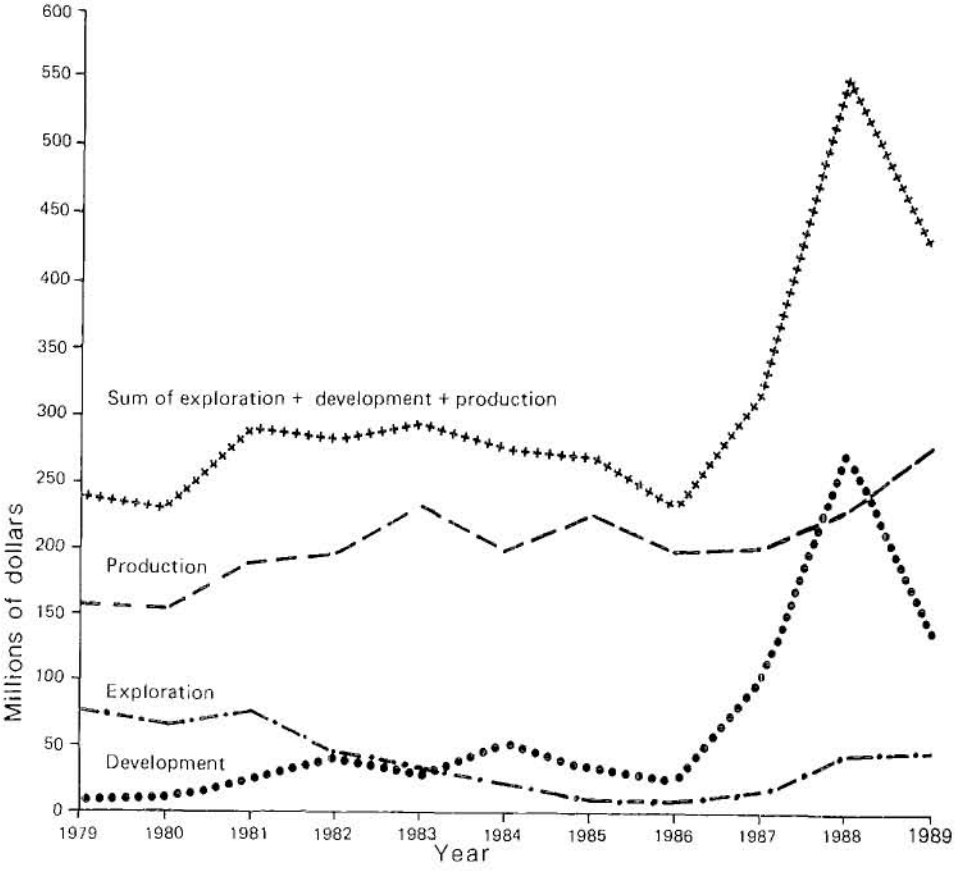


Figure 1. *Total value of mineral industry in Alaska, 1979-89.*

Table 1. *Total value of mineral industry in Alaska, 1987-89*

	1987	1988	1989
Exploration	$ 15,740,000	$ 45,468,800	$ 47,762,596
Development	100,250,848	274,945,400	134,272,350
Production	202,389,898	232,172,000	276,983,741
TOTAL	$318,380,746	$552,586,200	$459,018,687

[1]Alaska Division of Geological and Geophysical Surveys, 3700 Airport Way, Fairbanks, AK 99709.
[2]Alaska Division of Business Development, 1001 Noble St., Ste. 360, Fairbanks, AK 99701.
[3]Alaska Division of Business Development, P.O. Box D, Juneau, AK 99811.

MINERAL INDUSTRY EMPLOYMENT

The mineral industry employed 4,179 in 1989 compared to 4,353 in 1988, a decrease of 4 percent. Mechanized placer mining production accounted for 1,316 (31 percent) of the total followed by mineral development, 785 (19 percent); base metal production, 407 (10 percent); sand-and-gravel production, 625 (15 percent); recreational mining, 325 (8 percent); exploration, 252 (6 percent); lode gold and silver production, 161 (4 percent); and undistributed coal, tin, jade, soapstone, and stone production, 308 (7 percent). The small decline in total employment from 1988 to 1989 is due to a large (39 percent) decrease in mineral development projects. In contrast, overall production activities, especially base metal production, increased 13 percent from 1988 to 1989.

PRODUCTION

Gold was the most valuable mineral commodity in 1989, accounting for 39 percent of Alaska's total mineral production revenues. Zinc and silver each made up about 10 percent of the total; lead, 2.7 percent; and tin, another 0.3 percent. Platinum, tungsten, and mercury have all been produced in Alaska in past years, but recently, production figures for these metals have been withheld. Overall metallic mineral production accounted for 63 percent of total mineral values, reversing a 25-year period dominated by the nonmetallic materials: coal, sand and gravel, stone, peat, and jade, which account for the remaining 37 percent of the values.

The amount of gold produced in 1989--an estimated 284,617 oz (8,852 kg) worth $108.7 million--was the highest since 1950 and represents an increase of 7 percent by volume from 1988 levels. Despite the increase in production, total gold values were 4 percent lower than in 1988 due to lower bullion prices. Gold production was reported from 222 operations, a net gain of 11 from 1988. About 87 percent of the gold (247,948 oz; 7,712 kg) was recovered from 217 placer mines; the remaining 13 percent (36,669 oz; 1,140 kg) was recovered from five lode mines.

GREENS CREEK MINING COMPANY, the largest lode-silver mine in the United States during 1989 and the largest lode-gold mine in Alaska, recovered 9,585 tons (8,698 tonnes) of lead, 19,853 tons (18,007 tonnes) of zinc, 5,166,591 ounces (160,702 kg) of silver, and 23,530 ounces (732 kg) of gold from 264,680 tons of ore. The remaining lode gold was produced from several mines in interior and south-central Alaska, including the Ryan lode of CITIGOLD ALASKA INC., the Democrat mine of TRI-VALLEY MINING CO., and the Grant mine-and-mill complex of SILVERADO MINES U.S., INC., all located in the Fairbanks area, and the Independence mine of ALASKA HARDROCK MINING CO. at Hatcher Pass.

The Denali mine of the VALDEZ CREEK MINING COMPANY, situated near Cantwell, was again Alaska's largest gold mine, producing 71,942 ounces (2,237 kg) of raw gold. In spite of profitable operations, the mine was closed in late October. Because of the closure, overall Alaska gold production is expected to decrease, unless the mine resumes production in 1990.

ALASKA GOLD COMPANY continued gold-placer operations at Nome with two large onshore dredges and accounted for 21,000 ounces (653 kg) of gold. WESTGOLD's dredge Bima, mining offshore of Nome, recovered about 30,661 ounces (953 kg) of gold despite mechanical difficulties early in the season.

A total of about 194,000 lb (87,988 kg) of placer tin was produced, from the Seward Peninsula by LOST RIVER MINING COMPANY (LOST RIVER), Alaska's largest tin producer, and from the Manley Hot Springs area by SHOREHAM RESOURCES. LOST RIVER, however, exhausted its reserves and dismantled its operation late in the season.

COMINCO-ALASKA INC. began producing zinc concentrates late in the year from the Red Dog mine, which is owned by the NANA REGIONAL CORPORATION of northwest Alaska. Red Dog is expected to produce 440,000 tons (400,000 tonnes) of zinc concentrates for transport to foreign markets during the 1990 shipping season, which should make it the western world's largest zinc producer.

The sand-and-gravel and stone industries suffered significant setbacks during the year because of virtually no oil-and-gas infrastructure development on Alaska's North Slope and a continuing lull in urban-area construction projects. An estimated 14.5 million tons (13.15 million tonnes) of sand-and-gravel worth $39.9 million were produced in 1989, a decrease of 18 percent by volume and value from 1988 levels.

An estimated 2.9 million tons (2.6 million tonnes) of stone worth $20.3 million were quarried in 1989, a decrease by volume and value of 17 percent from 1988 levels. Given the reduced level of development on the North Slope and a weakened construction industry, these low levels are expected to continue to decline in 1990.

USIBELLI COAL MINE, INC. sold 705,258 tons (639,810 tonnes) of coal to the KOREAN ELECTRIC POWER COMPANY (KEPCO) in Honan, Korea, and fueled six interior power plants with 747,095 tons (677,764 tonnes) of coal for total coal production of 1,452,353 short tons (1,317,574 metric tons), a 6 percent decrease from the previous year. The KEPCO contract allows for coal shipments to range from 680,000 to 920,000 short tons; 1989 shipments reflect the lower end of the range.

DEVELOPMENT

Mineral development expenditures totaled $134.3 million in 1989, a 52 percent decrease from $274.5 million spent in 1988. The lower 1989 development expenditures reflect completion of the development phase of both the Greens Creek and Red Dog mine projects, which accounted for more than 95 percent of the 1988 development total. At Red Dog, COMINCO-ALASKA contracted several companies to assemble equipment and infrastructure at the mine and mill site, construct a conveyer at the port site, and strip the ore body in preparation for mining. WESTGOLD contracted PERATROVICH, NOTTINGHAM, & DRAGE INC. to design and construct an open-cell steel-sheet-pile dock off the Nome causeway to stage offshore-dredging activities. Thirty placer mining companies and three sand-and-gravel firms reported $10.5 million in development expenditures, all of which were used in preparation for mine production in 1990. IDEMITSU ALASKA spent $2 million in anticipation of exporting bituminous coal from the Wishbone Hill mining district near Palmer to Japanese markets.

EXPLORATION

Alaska mineral exploration expenditures surpassed the high level established in 1988, totaling $47.8 million. In contrast, mineral exploration generally declined in northwestern Canada and in many western states this past year. Returns from 61 mining firms and small partnerships working in Alaska indicate that precious metal exploration accounted for 91.6 percent of total mineral exploration expenditures, base metal exploration accounted for 6 percent, coal and industrial minerals exploration accounted for 2 percent and 0.4 percent, respectively. Individuals employed year-round in mineral exploration jobs in Alaska totaled 252.

Three advanced exploration projects accounted for 59 percent of statewide exploration expenditures: the Fort Knox project (FAIRBANKS GOLD INC.) near Fairbanks, and the Kensington and the Alaska Juneau projects (ECHO BAY MINES) near Juneau. The two big southeastern projects focused on reevaluation of past gold-producing mines, whereas the Fort Knox project explored a new discovery.

All other regions of the state experienced healthy levels of exploration activities. Companies that had notable exploration drilling programs include: NANA CORPORATION, PARADISE VALLEY MINING, and COMINCO-ALASKA in the northern region; CAITHNESS ALASKA, LIVENGOOD PLACERS, PLACER DOME INC., and WESTGOLD in the western region; PLACER DOME, NERCO MINERALS, FAIRBANKS EXPLORATION, USIBELLI COAL MINE, INC., and AMERICAN COPPER & NICKEL in the eastern interior region; COMINCO-ALASKA, VALDEZ CREEK MINING COMPANY, AMAX, PLACER DOME, and HOBBS INDUSTRIES in the southcentral region; WESTGOLD, CALISTA CORPORATION, and R.A. HANSON & COMPANY in the southwestern region; and PLACER DOME, LAC MINERALS, PULSAR and NEWMONT MINING in the southeastern region.

GOVERNMENT ACTIONS

Several significant legal or government actions affecting the future of Alaska's mineral industry took place in 1989. In May, the Alaska legislature amended certain state laws governing the location of state mining claims, and implemented rental and royalty fees for all mining on state lands. This legislation was in response to the Alaska Supreme Court's decision that section 6(i) of the Alaska Statehood Act required the state to collect rents and royalties from mining activity on state lands. The statute became effective August 31, 1989, and requires rent on mining claims, leasehold locations, upland, and offshore mining leases on all state land. Annual rent is due on September 1 and must be paid no later than November 30 of each year. Rents begin at $20 for each mining claim, $0.50 per acre for each mining lease, and will escalate through time. The Alaska Division of Mining (DOM) is currently drafting the regulation that will require the additional three percent net royalty payment from operating mines. Miners are currently required to pay an Alaska Mining License Tax on net income from mining activities on all Alaska lands, regardless of ownership.

In response to the successful operation of the Bima dredge in State of Alaska waters, the U.S. Minerals Management Service (MMS) issued a draft environmental impact statement (DEIS) for a proposal to offer to lease about 147,000 acres (59,491 hm^2) of federal offshore lands on the continental shelf. The DEIS identified the potential for mercury bioaccumulation in the food chain within the Nome area. Mercury had previously been used to amalgamate raw gold during placer mining operations in the area, and sporadic test results had showed some high levels of the element. Because of fears generated from the potential problem, the MMS delayed the lease sale and contracted BATTELLE NORTHWEST to conduct extensive metal analyses of water discharge from the Bima dredge, and from human-hair samples collected from Nome residents. Results showed that neither the levels of mercury in the discharge nor that in the hair samples exceeded established EPA standards. In fact, the first-year results show that levels of methylmercury in Nome residents are among the lowest of any indigenous coastal people in North America. The federal lease proposal is now expected to be completed in mid-1991, about 18 months behind the original 1989 schedule.

In related action, the DOM issued a pre-lease evaluation a "best interest finding" and the Division of Governmental Coordination (DGC) issued a "coastal consistency determination," regarding issuance of offshore prospecting permits within the state's "3-mile limit" near Nome. Later in the year additional state offshore leases were issued.

The number of small placer gold mines increased by 10 in 1989, mainly as a result of the resolution of a 1987 federal court injunction that had previously prevented or greatly limited mining activities on federal lands in the Fortymile River, and the Chatanika River, Beaver Creek, and Birch Creek drainages within the Circle mining district of interior Alaska. Recently implemented water recycling and reclamation laws, however, necessitated extensive mine-plan revisions, which resulted in lower than average bullion output by small placer mining companies statewide.

The U.S. Bureau of Mines (USBM) and DOM established a statewide claim information system adapted to a personal computer format. The program allows an individual to retrieve claim information by owner name, claim name, location, and state or federal numbering system. The system is available to individual users. DOM completed a comprehensive air photo survey of mining districts in eastern interior, northern, western, southwestern, and southcentral regions. These photos (scale 1" = 300') are available through the Fairbanks DOM office. DGGS has established a directory of Alaskan aggregate, rock, and soil producers, which includes 103 vendors statewide (Reger and Combellick, 1990).

EDUCATION AND RESEARCH

Several foreign exchange programs involving Alaska and Soviet geologists took place during 1989. During a 5-1/2 week period in August and September, 1989, an Alaska team of economic geologists visited mineral districts in the Magadan, Kamchatka, Kharbarovsk, and Primoryè regions of the Far East of the U.S.S.R. These field investigations were conducted as part of a two year reciprocal agreement, signed by the Far East Branch of the Soviet Academy of Sciences and the U.S. Geological Survey, to study the ore deposits of Alaska and the Soviet Far East. DGGS is officially participating in the project, which will result in publication of metallogenic maps of Alaska and the Magadan region at 1:2,500,000 scale, as well as other technical papers.

The Alaska Science and Technology Foundation funded an exchange between the University of Alaska Mineral Industry Research Laboratory and the All-Union Research and Scientific Institute of Gold and Rare Metals in Magadan to compare and contrast placer mining methods in the Magadan region with those in Alaska. In September 1989, four Alaska mining engineers visited placer developments in the Magadan region; in 1990 a similar contingent of Russian personnel will visit Alaskan placer mines.

A Soviet Far East gold mining association and Alaskan private interests formed a joint venture to develop mineral deposits and exchange mining technology. BERING STRAITS TRADING COMPANY, mining consultant RONALD SHEARDOWN and the Magadan-based gold organization SEVEROVOSTOK ZOLOTO ("NORTH EAST GOLD") formed the joint venture SVZAL in November 1989, with working capital of $2.3 million. The first Alaskan phase of the joint venture involves exploration and development of an underground placer mine on Little Eldorado Creek north of Fairbanks.

The ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY (AIDEA) obtained a Federal Clean Coal Technology grant that may facilitate construction of a state-of-the-art mine-mouth power plant and drying facility at Healy, Alaska in conjunction with mine operations of the USIBELLI COAL MINE, INC. The $93.2 million grant was one of 13 awarded nationwide by the Federal Department of Energy under the Clean Coal Technology Program.

ACKNOWLEDGMENTS

This report is designed, produced, and distributed by the Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys (DGGS), Division of Mining (DOM), and the Department of Commerce and Economic Development, Division of Business Development (DBD). Eight of the last nine reports covered under the above cooperative agreement have been published under the DGGS Special Report series.

We thank numerous data sources for their cooperation; that includes Alaskan mining exploration firms, placer miners, mine production companies, sand-and-gravel and other producers, Native regional corporations, and federal, state, and municipal agencies.

T.K. Bundtzen and John Roe (DGGS) mailed out 933 questionnaires on mining activity, 175 of which were returned by private firms, agencies, and individuals.

T.K. Bundtzen wrote the executive summary, exploration, and production sections; R.C. Swainbank (DBD) compiled the development, drilling and Native corporation sections; J.R. Deagen (DBD) supplied data on activities from southeast Alaska; Bundtzen wrote the section on metal

recycling and Soviet-Alaskan mineral and geology exchange; J.E. Wood (DOM), T.K. Bundtzen and J.L. Moore (DGGS) supplied data for appendices A and B; and Bundtzen and Swainbank modified appendices C, E, and F. Moore compiled appendix D from Department of Revenue records. Graphics and cartography were done under the supervision of A-L. Schell (DGGS); paste-up was completed by J.A. Outten (DGGS). M.W. Henning, J.E. Wood, and B.W. Campbell (DOM), reviewed the report; J.L. Moore edited the report; manuscript typing was done by R.A. Mann (DGGS).

Throughout the text, we have reported salient tables and statistics in both English and metric units of measurements in order to conform with widely accepted international standards. Some designations remain in English units when conversion to the metric system is judged to be irrelevant. The future format will be dependent on comments about this change.

EXPLORATION ACTIVITY IN 1989

INTRODUCTION

Mineral exploration throughout all surveyed regions of Alaska maintained the high expenditure levels established in 1988. Total exploration expenditures during 1989, with 63 mineral firms reporting, were $47,762,596 compared to $45,468,800 in 1988, an increase of 5 percent. Exploration expenditures are listed by commodity and region in tables 2 and 3, and shown graphically in figure 2. Following similar trends established in 1988, the highest expenditure level ($25.01 million; 52 percent) took place in the southeastern Panhandle. The eastern interior was second ($9.17 million; 19 percent), followed by southwestern ($4.58 million; 10 percent), western ($3.57 million; 7 percent), southcentral ($2.44 million; 5 percent), Alaska Peninsula ($2.01 million; 4 percent), and northern region ($983,000; 2 percent). The only region that saw a significant drop in exploration activity was southcentral Alaska, which dropped from $9.19 million in 1988 to $2.44 million in 1989, a decline of 73 percent. All other areas in the state maintained or increased their levels of activity. Mineral exploration supplied 90,872 man-days of employment, equivalent to about 252 full-time jobs, about the same as the previous year's total of 260. Fully 91 percent of total exploration expenditures were directed to the search for precious metals, similar to trends established in the mid-1980s.

The $656.94 million spent exploring for minerals since Alaska's statehood is broken down by region in table 4. The southeastern Panhandle leads exploration expenditures (113.4 million; 17.2 percent) followed by eastern interior ($80.8 million; 12.3 percent), southcentral ($62.2 million; 9.4 percent), northern ($55.3 million; 8.3 percent), western ($39.5 million; 6 percent), southwest ($25 million, 4 percent), and Alaska Peninsula ($23.9 million; 3.6 percent). However a large amount ($256.7 million; 39 percent) of the total exploration expenditures are combined because of the confidential stance of reporting companies, mainly during the 1970's. Since statehood about $260.2 million (40 percent) has been expended in the search for base metals, $298.1 million (45 percent) has been for precious metals (gold, silver, and platinum), $41.8 million (6 percent) has been for coal and nonmetallics, and the remainder ($59.1 million; 9 percent) has been for unspecified purposes. Overall trends for 30 years show a balanced search for a variety of minerals, in contrast to the extraordinary dominance of precious metal exploration observed in the last few years.

Claim staking activity decreased somewhat during the year. There were

Table 2. *Reported exploration expenditures in Alaska by commodity groupings, 1983-89*

	1983	1984	1985	1986	1987	1988	1989
Base metals	$ 9,758,760	$ 4,720,596	$2,397,600	$1,847,660	$ 2,523,350	$ 1,208,000	$ 3,503,000
Precious metals	20,897,555	14,948,554	6,482,400	6,107,084	11,743,711	41,370,600	43,205,300
Industrial minerals	2,068,300	270,000	--	170,000	286,000	160,200	125,000
Coal and peat	1,338,454	2,065,000	270,000	790,000	1,150,000	2,730,000	924,296
Other	70,000	279,500	--	--	31,000	--	5,000
TOTAL	$34,133,069	$22,283,650	$9,150,000	$8,914,744	$15,734,061	$45,468,800	$47,762,596

-- = No expenditures reported.

Table 3. *Reported exploration expenditures in Alaska by commodity and region, 1989*

	Northern	Western	Eastern interior	South-western	South-central	Alaska Peninsula	South-eastern
Base metals	$550,000	$ 40,000	$1,374,000	$ 553,000	$ 100,000	$ --	$ 886,000
Precious metals							
Placer	23,000	2,092,500	217,000	765,000[a]	131,600	--	--
Lode	350,000	1,435,000	7,430,500	3,225,000	1,489,700	1,990,000	24,056,000
Coal and peat	60,000	--	144,000	--	720,296	--	--
Industrial minerals	--	--	--	40,000	--	20,000	65,000
Other	--	--	5,000	--	--	--	--
TOTAL	$983,000	$3,567,500	$9,170,500	$4,583,000	$2,441,596	$2,010,000	$25,007,000
Employment							
(person-days)	1,400	8,437	25,438	5,455	6,077	2,810	41,255
(person-months)	46	281	848	182	202	94	1,375
Number of companies reporting	7	11	24	12	19	6	8

[a]Predominantly for platinum metals.
-- = No expenditures reported.

3,928 new state claims staked in 1989, compared to 8,062 in 1988; a decrease of 51 percent. Similarly, 1,664 new federal claims were staked in 1989 compared to 3,786 recorded in 1988; a decrease of 56 percent (figs. 3 and 4). Overall, active claims in 1989 totaled 69,715; a decrease of 8 percent from 1988 levels. These results seem to indicate that most exploration dollars are being spent on more advanced or established projects, in contrast to new grass roots exploration that involve new claim staking programs. These results are corroborated by examination of specific project expenditures. Three advanced exploration projects--the Fort Knox project (FAIRBANKS GOLD INC.) near Fairbanks, and the Kensington and Alaska Juneau projects (ECHO BAY EXPLORATION) near Juneau--accounted for 59 percent ($28.2 million) of statewide exploration expenditures. The two big southeastern projects focused on re-evaluation of past producing mines while the Fort Knox project explored a new discovery. Other "big spenders" include AMERICAN COPPER & NICKEL, WESTGOLD, PLACER DOME U.S., and BATTLE MOUNTAIN EXPLORATION CO., all of whom have expended most of their efforts on Native Corporation ground that does not involve claim staking programs.

The reduction of claim staking on state lands was also influenced in part by changes in state mining laws. The Alaska Supreme Court ruled that section 6(i) of the Alaska Statehood Act required annual rents on mining claims. Because these rent requirements go into effect in 1990, it is expected that more state claims will be dropped and perhaps substituted with state prospecting sites, which do not require annual rental fees.

Federal land policies continue to generally restrict mineral entry in Alaska. Currently 82 percent of all federal lands are closed to mineral entry, and additional restrictions are being proposed in the recent Tongass

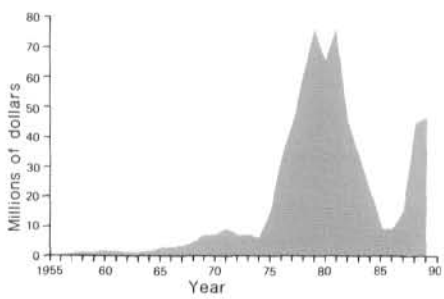


Figure 2. *Mineral exploration expenditures in Alaska 1955-89.*

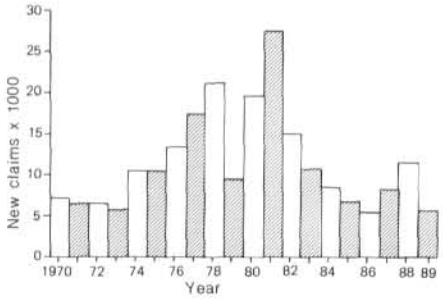


Figure 3. *New claims filed in Alaska, 1970-89.*

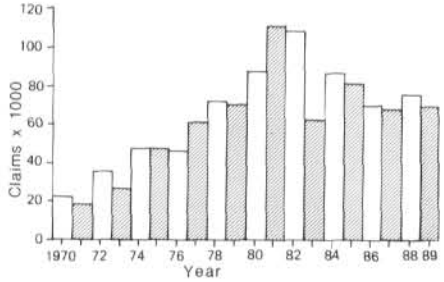


Figure 4. *Claim assessment work filed in Alaska, 1970-89.*

Table 4. *Reported Alaska mineral exploration expenditures by region, 1960-89*[a]

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Northern	0.60	--	--	--	--	1.18	--	--	0.71	0.65
Western	NR	--	--	--	--	NR	--	--	1.10	1.10
Eastern interior	0.16	--	--	--	--	0.18	--	--	0.12	1.22
Southcentral	NR	--	--	--	--	.09	--	--	1.00	1.00
Southwestern	NR	--	--	--	--	NR	--	--	0.05	0.20
Alaska Peninsula	NR	--	--	--	--	1.48	--	--	NR	NR
Southeastern	1.34	--	--	--	--	0.37	--	--	1.54	2.50
Unspecified	--	2.85	1.50	1.50	1.60	--	2.80	3.00	--	--
Total	2.10	2.85	1.50	1.50	1.60	3.30	2.80	3.00	4.52	6.67

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Northern	0.78	0.85	1.85	0.50	2.00	6.00	--	--	--	6.50
Western	1.23	1.50	2.20	2.00	0.20	0.50	--	--	--	1.50
Eastern interior	1.33	1.10	0.60	0.70	0.80	3.50	--	--	--	1.50
Southcentral	1.10	1.40	1.34	1.00	0.10	0.10	--	--	--	0.20
Southwestern	0.15	0.15	NR	NR	0.10	0.10	--	--	--	1.30
Alaska Peninsula	NR	NR	NR	NR	NR	NR	--	--	--	NR
Southeastern	2.28	4.00	1.95	2.50	2.80	1.65	--	--	--	4.50
Unspecified	--	--	--	--	--	--	25.00	42.50	58.50	61.00
Total	6.87	9.00	7.94	6.70	6.00	11.85	25.00	42.50	58.50	76.50

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Northern	4.10	4.50	14.93	2.52	2.56	1.86	0.60	0.62	0.99	0.98
Western	2.00	2.03	5.55	3.77	4.94	0.65	0.58	1.18	3.88	3.57
Eastern interior	3.10	21.66	9.48	9.17	3.21	1.75	2.38	3.34	6.33	9.17
Southcentral	NR	18.45	6.14	5.08	6.49	1.28	2.41	3.43	9.19	2.44
Southwestern	NR	8.70	3.81	1.32	1.02	0.12	0.18	0.61	2.63	4.58
Alaska Peninsula	NR	5.83	2.40	7.73	1.01	0.96	0.02	0.71	1.80	2.01
Southeastern	3.95	20.94	1.52	1.95	2.87	2.53	2.75	5.85	20.64	25.01
Unspecified	52.00	--	1.79	2.50	0.19	--	--	--	--	--
Total	65.15	82.11	45.62	34.04	22.29	9.15	8.92	15.74	45.46	47.76

[a]From Bundtzen and others (1982, 1983, 1986, 1987, 1988), Eakins and others (1983, 1984), Green (1989), Staff (1972, 1974, 1976), Williams (1960, 1961, 1965, 1966, 1968, 1969, 1971).

-- = No expenditures reported.

National Forest Plan revisions currently before Congress. In contrast, about 90 percent of all state lands are open to mineral development (Maas, 1987; Roberts, 1985; Bottge, 1987; and Bottge and Northam, 1987), however, many state mineral closures have involved lands of known mineral character. Future mineral activities are expected to shift from federal public domain to lands owned by the State of Alaska and Alaska Native Regional Corporations.

The U.S. Bureau of Mines (USBM) and the Alaska State Division of Mining (DOM) developed a computerized statewide mining claim information system (MCIS) in a personal computer format. Mining claim data for this project comes from Bureau of Land Management (BLM) and State Department of Natural Resources (DNR) records. The DOM, Fairbanks, has historically tracked both federal and state mining claims from recorded annual labor documents using the KARDEX numbering system. The USBM program is the first to integrate both state and federal systems.

The program, updated annually, allows an individual to retrieve claim information by owner name, claim name, location (meridian, township,

range, and section), BLM-ADL serial number, and KARDEX number. This program is available for use at USBM offices in Juneau, Fairbanks, and Anchorage, and the DOM office in Fairbanks. The USBM in Juneau will provide a copy of the entire program to any individual user upon receipt of four double-sided 1.44 Mb diskettes.

Discussion of statewide mineral activity is divided into regional divisions as shown in figure 5 and the locations of selected projects are highlighted in figure 6.

NORTHERN REGION

The northern region covers about 30 percent of Alaska's landmass and includes some of the state's least populated and most remote geographic areas, such as the Brooks Range and North Slope. Reported 1989 expenditures totaled $983,000, essentially unchanged from the $993,000 reported in 1988. Seven companies reported that 46 person-months of employment were expended on precious, base metal, and coal projects.

METALS

COMINCO-ALASKA INC. explored for lead and zinc deposits in the Noatak district directly west of the giant Red Dog lead-zinc-silver deposit and conducted a limited drilling program (loc. 1, fig. 6). NANA REGIONAL CORPORATION conducted reconnaissance geologic mapping and geochemical sampling of ANCSA lands throughout the western Brooks Range.

In the Shungnak district STEWARTS PHOTO INC. explored for placer gold deposits near jade mines they formerly operated.

Further to the east, in the Chandalar district, LITTLE SQUAW MINING CO. completed reconnaissance work on both placer and lode deposits in Tobin Creek valley. Late in the year GOLD DUST MINES INC. (Del Ackels) entered into a lease agreement to develop and produce placer gold in three of four creeks held by LITTLE SQUAW.

DENNIS ANDERSON explored for placer gold in Smith, Marion, and Clara Creeks of the Wiseman district. SILVERADO MINES U.S., INC. ran VLF-EM surveys over lode and placer prospects on Nolan Creek near Wiseman, and reclaimed past-mined placer ground (loc. 2, fig. 6). PARADISE VALLEY INC. completed cross cuts on placer ground in the Birch and Agnes Creek drainages near Wild Lake, west of Wiseman, and completed 580 ft (177 m) of rotary drilling. They also completed sampling and assay work on several nearby gold-bearing lodes.

COAL

ARCTIC SLOPE REGIONAL CORPORATION continued their investigations of coal deposits in the Deadfall syncline area of northwest Alaska (Merritt and Hawley, 1987). Exploratory work in 1989 mainly consisted of the removal of several hundred tons of bituminous coal for bulk analytical tests (loc. 3, fig. 6). Late in November, ARCTIC SLOPE submitted a surface coal mining permit application to the DOM, and it is currently being reviewed (Peterson, 1989).

WESTERN REGION

METALS

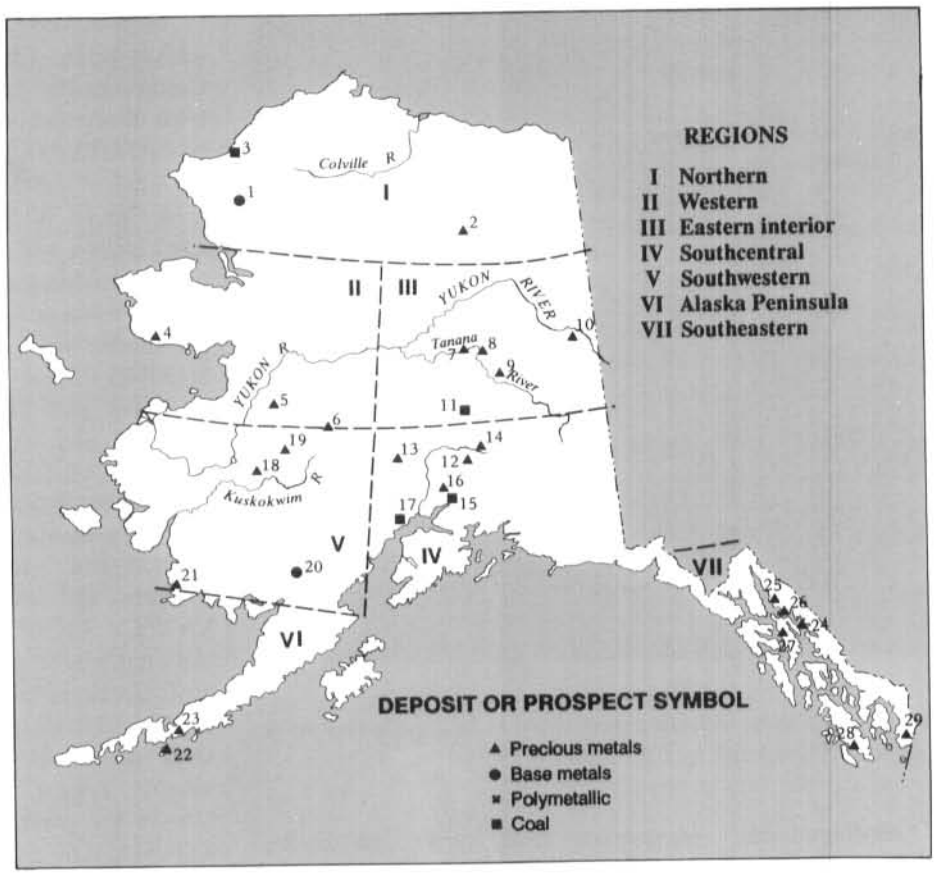
Mineral expenditures in the western region totaled $3.57 million in 1989, compared to $3.88 million in 1988, an 8 percent decrease from the previous year. Exploration was dominated by large companies searching for placer and lode gold deposits.

PLACER DOME U.S., operator for GOLDEN CREEKS JOINT VENTURE (GCJV) continued intensive exploration of the Rock Creek area about 8 miles (12 km) north of Nome, Alaska (loc. 4, fig. 6). The Rock Creek-Sophie Gulch

Figure 5. *Regions of mineral activity in Alaska.*

prospect consists of a series of parallel northeast-trending near-vertical quartz-sulfide veins that intrude greenschist facies lithologies of the Nome Group (fig. 7). The deposit is considered an example of a mesothermal "mother lode" type of gold deposit as typified in other northern Cordillera mineral belts. PLACER DOME has completed 60,000 ft (18,290 m) of core drilling since project inception in 1987 at a cost of approximately $4 million.

In 1989, PLACER DOME collected a 132 ton (120 tonne) bulk sample from a centrally located surface pit and shipped it to Vancouver, B.C. for metallurgical testing. The tests indicated the quartz veins in the bulk sample yielded free-milling gold with a projected recovery of about 92 percent using grinding and flotation methods. In September GCJV announced the deposit contained drill-indicated reserves of 6.66 million tons (6.04 million tonnes) at an average grade of 0.071 oz/ton (2.4 g/tonne) or a contained resource of 473,000 oz (14,712 kg) of gold. However, late in the year, PLACER DOME announced to GCJV that it was withdrawing from the project. ASPEN EXPLORATION, the current operator for the joint venture, announced at the end of the year that 1990 exploration plans were being formulated; ASPEN also announced an option agreement with TENNECO MINERALS to continue gold exploration in the general Rock Creek area.



NORTHERN REGION (I)

1. Cominco-Alaska Exploration (Noatak)
2. Silverado Mines U.S. (Nolan Creek)
3. Arctic Slope Regional Corporation (Deadfall syncline)

WESTERN REGION (II)

4. Placer Dome (Rock Creek)
5. Goldmor (Illinois Creek)
6. Caithness Alaska (Nixon Fork)

EASTERN INTERIOR (III)

7. Silverado Mines U.S. (Ester Dome)
8. Fairbanks Gold Inc. (Fort Knox)
9. Tri-Valley Mining (Richardson district)
10. Palomar (Flume Creek)
11. Usibelli Coal Mine (Healy)

SOUTHCENTRAL (IV)

12. Amax Exploration (Gold Hill)
13. Cominco-Alaska Exploration-Platinova (Mt. Estelle)
14. Valdez Creek Mining Co. (Denali Mine)
15. Alaska Hardrock Mining (Hatcher Pass)
16. Hobbs Industries (Castle Mountain Mine)
17. Diamond Alaska and Placer Dome U.S. (Beluga coal field)

SOUTHWESTERN REGION (V)

18. Westgold (Donlin Creek)
19. Battle Mountain (Granite Creek)
20. Cominco-Alaska Exploration (Sleitat)
21. R.A. Hanson Co. (Goodnews Bay)

ALASKA PENINSULA (VI)

22. Alaska Apollo Mines (Unga Island)
23. Battle Mountain Exploration (Sand Point, Popof Island)

SOUTHEASTERN (VII)

24. Echo Bay Exploration (A.J.)
25. Echo Bay Exploration (Kensington)
26. Placer Dome U.S. (Jualin)
27. Greens Creek Mining Co. (Mariposite)
28. Lac Minerals (Niblack, Ruby, Tuesday)
29. Pulsar Resources (Hyder area)

Figure 6. *Selected mineral exploration projects in Alaska, 1989.*

Figure 7. *Parallel auriferous quartz veins intruding greenschist in bulk sampling pit at Rock Creek. Photograph by C.C. Hawley, 1989.*

WESTGOLD INC. continued exploratory drilling offshore in both State of Alaska and federal waters. Aggressive exploration is anticipated with acquisition of new state and federal offshore leases currently being prepared.

BHP-UTAH INTERNATIONAL performed field work on CIRI's Kelly Creek prospect in eastern Seward Peninsula that emphasized soil grids and delineation of drill targets.

GOLDMOR RESOURCES leased the Illinois Creek deposit southwest of Kaiyuh Hills (loc. 5, fig. 6), and evaluated the oxidized base metal-precious metal property as a potential heap leach operation. Discovered by ANACONDA MINERALS in 1980, the Illinois Creek deposit is the largest of several polymetallic gold-bearing gossans in a 9-mile-long (15-km) stratigraphic belt in the Kaiyuh Hills (Gillerman, 1988). Three major deposits and many prospects are hosted in Paleozoic quartzite and are aligned parallel to the N. 70° E.-trending Kaltag fault, a major transcurrent fault in western Alaska. Past exploration work to date consisted of 29,871 ft (9,107 m) of trenching, diamond core drilling, and reverse circulation drilling; 3,656 ft (1,114 m) of the reverse circulation work was completed in 1989. Reserves of the deposit are estimated at 1.7 million tons (1.54 million tonnes) grading 0.071 oz/ton (2.4 g/tonne) gold, and 2.05 oz/ton (70 g/tonne) silver. In 1989, a five ton bulk sample was removed from the property to ascertain its amenability to heap leaching technology.

CENTRAL ALASKA EXPLORATION CORPORATION, operator for CAITHNESS ALASKA MINING CO. and NIXON FORK MINING CO., optioned the Nixon Fork gold deposit from BATTLE MOUNTAIN EXPLORATION CO., which had previously outlined a 320,000 oz (9,953 kg) gold resource in high-grade skarns averaging 1.105 oz/ton (38 g/tonne) gold (loc. 6, figs. 6 and 8). The Nixon Fork copper-bismuth-gold deposit occurs in roof pendants and irregular replacement bodies of skarn in recrystallized Ordovician limestone--usually within 130 ft (40 m) of a Late Cretaceous monzonite pluton (Nokleberg and others, 1987). Drilling by CAITHNESS in 1989 returned 38 ft (11.6 m) of 1.043 oz/ton (36 g/tonne) gold and 30 ft (9.2 m) grading 2.582 oz/ton (88 g/tonne) gold from two selected holes.

Small placer firms also reported exploration work. LOST RIVER MINING drilled gold-tungsten placers on Anvil and Tripple Creeks in the Nome district. GREEN MINING & EXPLORATION trenched and drilled deep placer deposits on Long Creek in the Ruby district, south of the Yukon River, and calculated remaining reserves and overburden-pay ratios. SWIFT CREEK MINING also explored placer ground near Ruby on Swift Creek, in the Kaiyuh Hills. TOLSTOI MINING CO. sank a prospect shaft on Boob Creek and sampled nearby Tolstoi, Ledge, and Hurst Creeks for placer platinum potential. KOUGAROK MINING conducted a limited drilling program on buried placer deposits in the Kougarok River drainage of central Seward Peninsula.

EASTERN INTERIOR REGION

The eastern interior is the source of about 60 percent of all the placer gold mined in Alaska, from mines in the Fairbanks, Circle, Livengood, Fortymile, Manley-Tofty, and Richardson districts of the Yukon-Tanana Upland. Additionally, deposits of antimony, tungsten, lead, and zinc have also been exploited during times of market demand. Reported mineral exploration expenditures were $9.17 million, up 44 percent from $6.33 million in 1988, and the highest level since 1983. This region showed one of the strongest increases in exploration in the state. Companies reported 25,438 man-days of employment, or an equivalent of 70 full-time jobs.

METALS

SILVERADO MINES U.S., INC. conducted an aggressive exploration program on Ester Dome, and near Eagle Creek, in the Fairbanks district (loc. 7, fig. 6). The Ester Dome work was a continuation of exploration and development of past productive properties such as the Grant, Irishman, Ethel-Elmes, Silver Dollar, Ready Bullion, and other company holdings in the area.

The largest exploration project in the eastern interior was conducted by FAIRBANKS GOLD INC., on the north side of Gilmore Dome about 15 miles (24 km) northeast of Fairbanks, Alaska (loc. 8, fig. 6). Originally described as the Monte Cristo or Melba prospect (Chapman and Foster, 1969), the "Fort Knox" deposit consists of free gold and bismuth-tellurium-tungsten sulfides and sulfosalts in thin quartz veinlets that intrude along N. 70° W. vertically dipping shear zones or fault structures in a complex granodiorite pluton--the structural orientation is the same as veins observed in the Cleary Hill area to the north (Hill, 1933). The thin veins intrude several phases of 85-to 90-million-year-old quartz monzonite (Forbes, 1982).

WGM INC., operator for FAIRBANKS GOLD LTD., who control the property (51 percent), conducted 52,000 ft (15,850 m) of rotary drilling (by ALSINCO INC.), 14,000 ft (4,267 m) of diamond core drilling (by NANA-COATES), as well as 24 trenches and bulk sampling programs (fig. 9). About 45 people worked on the property in 1989. In December 1989, Eric Friedland, President of FAIRBANKS GOLD LTD., announced that four independent resource calculations on the Fort Knox deposit have delineated a drill-indicated resource of 80- to 100-million-tons (73 to 91 million tonnes) averaging 0.035 to 0.047 oz/ton (1.2 to 1.6 g/tonne) gold. The deposit contains an estimated 3.1 to 4.2 million oz (96,423 to 130,637 kg) of gold, making it one of Alaska's largest known hard-rock gold resources. The drill-indicated resource includes intercepts within a 2,700-ft (823 m) by 1,200-ft (365 m) mineral zone and does not include mineralized zones known to be adjacent to the target area. The deposit appears to be open ended in several directions.

Figure 8. *The old Nixon Fork mill, which was in intermittant operation from 1918 to 1960. Photograph courtesy of Caithness Alaska Inc., 1989.*

Figure 9. *The Fort Knox exploration project, northeast of Fairbanks, Alaska. Photograph by R.C. Swainbank, 1990.*

Seven composite bulk samples from drill material were submitted to LAKEFIELD METALLURGICAL LABORATORIES in Ontario, Canada. The results showed 95- to 97-percent gold recoveries at minus 65 to minus 200 mesh test sizes using a carbon-in-pulp cyanidation process. The economics of mining and milling rates of 20,000- to 30,000-tons-per-day (18,144- to 27,210-tonnes-per-day) from an open pit mining operation are currently in review. FAIRBANKS GOLD announced that $9.3 million in exploration would be spent on the property in 1990.

Recent work by Solie and others (1990) and Newberry and others (1990) use geochemistry and K-Ar age data from intrusive rocks to predict lode gold potential in intrusive rocks in the Yukon-Tanana Upland. This may allow prediction of favorable intrusive bodies in gold exploration.

NERCO MINERALS conducted exploration and detailed metallurgical studies of the Liberty Bell (gold), WTF (gold, base metals), and Delta district (gold, silver, zinc, lead) properties in the Alaska Range in joint venture with PHELPS DODGE. NERCO also joint ventured exploration of their Gilmore Dome gold prospects in the Fairbanks district with TERYL RESOURCES.

FAIRBANKS EXPLORATION INC. conducted mapping, geochemical sampling, bulk sampling, and drilling on precious metal properties in the Livengood, Circle, and Fairbanks districts; ASARCO INC. was a joint venture partner in the Livengood work.

TRI-VALLEY MINING COMPANY explored a 64-mile^2 (164 km^2) claim block covering the Richardson Lineament (Bundtzen and Reger, 1978) and virtually the entire Richardson mining district, located about 60 miles (97 km) southeast of Fairbanks (loc. 9, fig. 6). Target zones include structurally controlled quartz-orthoclase-porphyry intrusions that contain significant gold and silver values. The company operated a pilot mine on the Democrat zone in the district, and produced gold-silver bullion bars.

PALOMAR CAPITAL CORPORATION (PALOMAR) entered into a 50-50 joint venture with CAITHNESS GOLD MINING to explore further 3.5 million acres of land owned by DOYON LTD., Alaska's largest native regional corporation. The joint venture, which is known as CAITHNESS GOLD MINING, holds an exclusive seven-year option to explore and lease certain lands owned or controlled by DOYON. During 1989, PALOMAR investigated the Flume Creek "mother lode" gold deposit near Eagle and the Indian Mountain volcanogenic epithermal gold systems. The joint venture is also active on DOYON lands in western Alaska (loc. 10, fig. 6).

GRATEFUL DOG MINING (Roger McPherson) investigated a gold-bearing igneous body on Hattie Creek in the O'Conner Creek drainage of the Fairbanks district, using geochemical, magnetometer, and drilling techniques.

Placer mining operations explored for new placer reserves throughout the eastern interior. DENNIS SHEPPARD explored placer deposits in Bottom Dollar Creek in the Circle district. HERNING EXPLORATION & MINING (Bruce Herning) explored placer ground on Palmer Creek, a tributary of the East Fork of the Chena River. Long-time placer miner WALTER ROMAN explored extensions of his paystreak on Pearl Creek, a tributary to Fish Creek in the Fairbanks district. GERAGHTY MINING trenched and dug test pits on the Old Smokey antimony-gold vein deposits on Amy Dome in the Livengood district. TOM VAN OSTRAND looked for placer gold in the Jumbo Dome area near Healy. PAUL BARELKA searched for placer gold and drilled placer paystreaks in the Nome Creek area northeast of Fairbanks. BRUCE SAVAGE tested Killarney Creek in the Manley-Tofty district for placer deposits of tin and gold.

COAL

USIBELLI COAL MINE, INC. conducted a significant exploration program in the Healy coal field in search of future reserves for mine production; the current Poker Flats mine site contains 8-10 years of reserves at current mining rates, but new markets could result in increased production and a shortened reserve life (loc. 11, fig. 6). Exploration targets drilled include the Gold Run Pass, Francis Ridge, North Fork Ridge, Mosquito Ridge, and South Slope areas.

BILL WAUGAMAN sampled outcrops of coal for heating tests in the California Creek drainage, which is also in the Healy coal field.

SOUTHCENTRAL REGION

The southcentral region includes the Valdez Creek mining district, the Kennecott copper belt, and the copper and lode gold mineral belts from Valdez to Seward. A variety of metals and minerals have been developed and promising coal, gold, and base metal properties have been explored in recent years. However, 1989 expenditures declined significantly from 1988 levels--from $9.19 to $2.44 million--a decrease of nearly 70 percent.

METALS

HUNT, WARE, & PROFFETT continued a maintenance-level exploration program of the Johnson River volcanogenic massive sulfide prospect in the southern Alaska Range, west of Anchorage. This promising high-grade gold-zinc property is owned by COOK INLET REGION INC. and is leased by HOWARD KECK and partners.

CAN ALASKA RESOURCES explored a 5 mile^2 (13 km^2) area on "Rainbow Hill," a possible lode source for placer gold mined at the Denali mine, Alaska's largest gold producer. Drill hole intercepts on the TMC Zone

encountered in 1989 included 40 ft (12 m) grading 0.33 oz/ton (11 g/tonne) gold, and 40 ft (12 m) grading 0.20 oz/ton (6.8 g/tonne) gold in altered granodiorite near the Black Creek fault zone.

AMAX EXPLORATION conducted a sampling and drilling program on their Gold Hill hard-rock gold prospect about 10 miles (15 km) southwest of the Denali placer gold mine (loc. 12, fig. 6). The exploration area includes Jura-Cretaceous flysch and altered igneous lithologies and shows similarities to those in the headwaters of the Valdez Creek drainage, the source of the placer gold at the Denali mine.

FRONTIER SERVICES collected bulk samples and trenched the Palmer Creek lode gold deposit on the Kenai Peninsula, the region's largest past producer of lode gold.

COMINCO-ALASKA EXPLORATION, in a joint venture with PLATINOVA, continued to explore large low-grade gold and base metal resources in the Rainy Pass-Mt. Estelle area of the western Alaska Range (loc. 13, fig. 6). The joint venture has reported up to 300-ft-long (91 m) drill intercepts that yield 0.22 percent copper and 0.033 oz/ton (1.1 g/tonne) gold over large areas of mineralized intrusive and altered country rock in the district. The company conducted 4,400 ft (1,341 m) of drilling on the properties in 1989. COMINCO-ALASKA independently investigated base metal and precious metal occurrences in the Rainbow Mountain-Cantwell Glacier area near Paxson, where lode deposits of platinum metals have been recently evaluated.

DAN RENSHAW maintained exploration work at the Gold Cord and Sheared properties in the Hatcher Pass district, and may begin small scale production of high-grade gold ores in the near future.

ALASKA HARDROCK MINING COMPANY established survey controls and bulk sampled gold vein deposits in the Gold Bullion and Independence mines at Hatcher Pass, north of Palmer (loc. 15, fig. 6). The deposits contain possible or inferred reserves of 50,000 tons (45,360 tonnes) of high-grade gold ore.

Placer resources in the southcentral region were vigorously explored during the year. VALDEZ CREEK MINING COMPANY (VCMC) explored Windy Creek and extensions of paystreaks they have exploited (fig. 10) (loc. 14, fig. 6). VCMC's Denali mine has been Alaska's largest gold mine for five of the last six years. Exploration for placer gold in the Valdez Creek district by other companies was intense. ROWALLAN MINING PARTNERSHIP continued to explore and develop their Blue Sky, White Creek and Northern Lights claim blocks on and near White Creek, about 4 miles (6.4 km) upstream from the Denali mine. STEVENS EXPLORATION, which has conducted much of the exploration for the partnership, has encountered significant reserves of placer gold that exhibit similar gold values to those that encountered at the Denali mine, covered by significantly thinner overburden. Based on about 10,000 ft (3,048 m) of rotary drilling, ROWALLAN MINING estimates the property contains a minimum of 55,000 oz (1,710 kg) of gold.

Small placer exploration projects were active region-wide. GOODROCK PLACER ASSOCIATION INC. tested bedrock concentrations of gold on Canyon Creek and Mills Creek on the Kenai Peninsula. H&H EXPLORATION & MINING also explored Mills Creek in the same area using a Nodwell-mounted backhoe. FREDERICK HAAS explored Dianne and Canyon Creeks of the same (Hope-Sunrise) district using hand tools and a small suction dredge. JIM HALLORAN blocked out a small (3,000-yd^3; 2,295 m^3) reserve of placer gold on upper Willow Creek in the Hatcher Pass district, north of Palmer. RECOVERY SYSTEMS INC. explored unspecified areas of the Valdez and Prince William Sound regions looking for placer gold. BOB TITCHEVAL explored for platinum and gold in the Nelchina district near Talkeetna. BLACK SANDS MINING COMPANY looked for placer deposits of gold and silver on

Figure 10. *VCMC drill rig delineating the upper paystreak upstream from the Denali mine. Photograph by T.K. Bundtzen, 1989.*

Willow Creek, north of Palmer. ED ELLIS conducted hand sampling and bulk sampling of Tertiary conglomerates in the Lake Creek area of the Cache Creek district and found them to be auriferous. HOFFMAN MINING searched for placer deposits of precious metals in the Chistochina district east of Paxson.

COAL

Exploration of coal deposits in southcentral Alaska was at its highest level in nearly seven years. It would appear that these efforts may result in positive development decisions that will lead to both export and local markets for the region's coal.

HOBBS INDUSTRIES, INC. conducted a systematic reverse circulation drilling program on the old Castle Mountain coal mine in the Wishbone Hill district near Palmer (loc. 16, fig. 6). The company drilled 14 holes and calculated inferred reserves of 3,888,000 tons (3.52 million tonnes), indicated reserves of 1,589,760 tons (1.44 million tonnes) and measured reserves of 159,800 tons (144,970 tonnes) of high-grade bituminous rank coal, all hosted in the Tertiary Chickaloon Formation. The CASTLE MOUNTAIN coal mine project is progressing toward a projected start-up in 1990 or 1991 with anticipated annual production of 25,000 tons (22,680 tonnes) annually. The secured market for the project is the Department of Defense Backscatter Radar coal-fired power plant located in Gulkana. Coal heating tests are anticipated in 1990 and 1991. DAMES & MOORE and RENSHAW ENGINEERING have been consultants for HOBBS INDUSTRIES on the project.

IDEMITSU ALASKA conducted final exploratory work on their WISHBONE HILL coal mine project and further refined their minable reserve estimates. Exploration operator McKINLEY MINING CONSULTANTS has identified 14.5 million tons (13.2 million tonnes) of measured reserves of high-grade bituminous coal through detailed drilling and sampling efforts. This project is further described in the Development section.

DIAMOND ALASKA COAL COMPANY and PLACER DOME U.S. both conducted limited bulk sampling of large reserves of subbituminous coals in the Beluga coal field, west of Anchorage (loc. 17, fig. 6). Development of these properties, which have essentially reached the development stage, has been hindered by the poor export marketability of the subbituminous coal resource. However, the installation and successful operation of a proposed experimental coal-drying facility at Healy by UCM, INC. could help stimulate the development of the enormous Beluga coal resources, located near tidewater and readily available for export.

SOUTHWESTERN REGION

The southwestern region includes numerous lode and placer deposits originating in the "Kuskokwim mineral belt," a 400-mile-long (640 km) northeast-trending zone of Late Cretaceous-early Tertiary metal-bearing volcanic and plutonic rocks. Mining districts include Goodnews Bay, Aniak, Iditarod, Innoko, Candle Creek, and Iliamna. The region has produced about 10 percent of Alaska's gold (2.8 million oz; 87,092 kg), nearly all of Alaska's platinum metals (575,000 oz; 17,885 kg refined), and all of Alaska's 41,000 flasks (1,413,417 kg) of mercury production. Mineral exploration expenditures reached $4.58 million in 1989, a 24 percent increase from the $3.68 million spent in 1988. Long dormant, southwestern Alaska has become one of the top areas of grassroots exploration efforts by recently arrived mining firms, most working on State of Alaska and Native Corporation lands.

METALS

WESTGOLD leased ground from CALISTA CORPORATION and explored several hard-rock and placer gold properties in the Aniak district. Specifically, a major drilling program was continued on mineralized gold-antimony-bearing quartz porphyry dikes and sills of Late Cretaceous (66 Ma.) age in the Donlin Creek area (loc. 18, fig. 6). To date, at least 40,000 ft (12,192 m) of diamond core and rotary drilling has delineated a major low-grade bulk tonnage gold resource in both quartz porphyry and altered wall rock. WESTGOLD collected a large bulk sample and shipped it to a Nevada test facility for leaching recovery analyses. WESTGOLD also investigated the feasibility of mining placer deposits in the Nyac district, and looked at the gold potential of the Red Devil mercury mine area, Alaska's largest past producer of mercury.

BATTLE MOUNTAIN continued an extensive sampling, trenching, and drilling program on Granite Creek, a tributary to the George River in the central Iditarod Quadrangle (loc. 19, fig. 6). Lode deposits thus far identified consist of structurally controlled zones of stibnite and free gold in quartz veinlets--both ore types associated with quartz porphyry bodies similar to those being explored by WESTGOLD at Donlin Creek.

HUNT OIL COMPANY (MINERALS DIVISION) maintained 92 state mining claims (about 5.7 mi^2; 14.8 km^2) covering gold and base metal skarn mineralization adjacent to a Tertiary granitic stock on Big River in the Lime Hills D-4 Quadrangle.

JIM WYLIE trenched and bulk sampled his Mountain Top mercury deposit, one of the only cinnabar lodes in southwestern Alaska that assays anomalous gold.

COMINCO-ALASKA EXPLORATION continued a maintenance level program at the promising Sleitat tin-tungsten deposit on Sleitat Mountain 70 miles (112 km) west of Iliamna (loc. 20, fig. 6). The deposit consists of 3,000-ft-long (914 m), east-west-trending vertical greisen zones in

57 Ma. old binary granite that contain high-grade cassiterite and wolframite concentrations. One drill hole intersected 85 ft (26 m) of 1.8 percent tin and 0.4 percent tungsten.

MISCO-WALSH MINING CO. continued an extensive trenching program at the Golden Horn mineralized region near the confluence of Black and Otter Creeks in the Flat area, and extended their nine-year exploration-development work into the antimony-rich Mining Gulch area.

JULIAN CREEK MINING bulk sampled auriferous quartz porphyry dikes and sills on Julian Creek, east of Flat, in conjunction with placer gold mining activities there.

DON HARRIS conducted geophysical profiles on the Broken Shovel silver-gold lode on Moore Creek, a tributary to the Takotna River southwest of McGrath.

Small placer operations reported exploration efforts on their claims. PRINCE CREEK MINING COMPANY (ALVIN AGHOFF) dug test pits with a dragline on Prince Creek near Flat, searching for further reserves of placer gold. WILBUR and ANN WILLIAMS tested ground on Granite Creek, also in the Flat district. LITTLE CREEK MINING COMPANY (Paul Sayer), hand prospected Little Creek, a tributary to the Innoko River in search of more of the placer reserves he has mined there for many years.

The largest exploration effort for placer resources was conducted by R.A. HANSON CO. INC. in the Goodnews Bay district (loc. 21, fig. 6). The company drilled clay-rich reserves, dewatered wells, tested for water table saturation, and attempted to drive an adit into deep placer resources of platinum on the lower Salmon River, site of the nation's largest placer platinum dredging operation (1938-75).

The company announced plans to re-mine clay tailings and some gravel tailings using open cut methods, and to mine virgin ground using underground methods.

ALASKA PENINSULA

METALS

The Alaska Peninsula region includes the Tertiary plutonic-volcanic rocks of the Alaska-Aleutian arc and recent Quaternary volcanoes of the Aleutian Chain. Mineral exploration during 1989 in this classic epithermal gold setting amounted to $2.01 million compared to $1.71 million in 1988, an increase of 18 percent.

ALASKA APOLLO GOLD MINES INC. continued exploration of the Shumigan and Apollo ore deposits, conducting 7,262 ft (2,214 m) of diamond core drilling on several claims (loc. 22, fig. 6).

Current reserves amount to 208,260 tons (188,933 tonnes) grading 0.765 oz/ton (26.2 g/tonne) gold and 3.50 oz/ton (120 g/tonne) silver.

BATTLE MOUNTAIN EXPLORATION COMPANY continued aggressive exploration on mineral deposits on ALEUT CORPORATION lands throughout the region and focused on their Centennial (Popof Island) and Unga Island projects (loc. 23, fig. 6). Drilling programs were conducted on both of these epithermal gold-silver mineralized systems.

The Mount Dana ash flow tuff about 40 miles (64 km) west of Sand Point is a unique discovery of gold in a volcanic ash that is being studied by BATTLE MOUNTAIN. Gold can be panned from the Early Holocene ash virtually anywhere in the 24-miles^2 (62 km^2) outcrop area.

SOUTHEASTERN REGION

The Panhandle of Alaska received the largest exploration effort of any area of the state, accounting for $25.01 million in expenditures, about half of the statewide total. Mineral deposits under investigation include vein, vein disseminate, massive sulfide, and skarn types.

METALS

ECHO BAY EXPLORATION INC. (ECHO BAY) increased its activity in Juneau with progress on both its large projects, the A-J (Alaska Juneau), just outside of town, and the Kensington, 40 miles (64 km) north of Juneau.

The historic Alaska Juneau gold deposit is the largest past producer of lode gold in Alaska, accounting for about 3.1 million ounces (96,400 kg) of gold from 1893 to 1944. The A-J consists of northwest striking swarms of steeply dipping auriferous quartz veins hosted in upper greenschist facies amphibolite and phyllite within a zone 5-km-long, 150-m-wide and 1,000-m-down dip (Newberry and Brew, 1988, Fredericksen and Miller, 1989). At the A-J project, ECHO BAY drilled 35,000 ft (10,670 m) during 1989, further delineating the reserves of the huge low-grade deposit (loc. 24, fig. 6). ECHO BAY holds an 85 percent interest in the project with WATTS, GRIFFIS, McQUAT LTD. (WGM) holding a 15 percent carried interest. Drilling during 1989 was by NANA-COATES and WINK INTERNATIONAL. The 1989 year-end minable reserves totaled 44.6 million tons (40.4 million tonnes) averaging 0.051 oz/ton (1.7 g/tonne) gold. Approximately 80,000 ft (24,390 m) of additional drilling is planned for 1990 to refine and expand this reserve base.

In addition to this diamond drilling program, ECHO BAY drove 1,500 ft (457 m) of drifts and crosscuts to establish additional drill stations underground. Work on the drifting, ramps, and raises was contracted to CENTENNIAL DEVELOPMENT (fig. 11). In previous years, ECHO BAY shipped 1,450 tons (1,315 tonnes) of ore for metallurgical testing, did geotechnical and mine design work, and tested blasting and cratering techniques. The results of the 1989-90 work program are expected to provide sufficient information to allow the company to conclude its final feasibility study contracted to KILBORN ENGINEERING.

Figure 11. *Locomotive used to tram the crew underground in the Alaska Juneau mine. Photograph by T.K. Bundtzen, 1989.*

In early 1989, ECHO BAY began an environmental assessment program on the A-J, the first step in seeking regulatory authorization for the construction of the project. Preliminary development plans envision a 22,500 ton-per-day (20,412 tonne) underground mining operation producing 350,000 oz (10,886 kg) of gold per year. The capital costs for development of the A-J are estimated at $220 million; the project would employ a work force of about 450 to mine the low-grade vein swarm during an estimated operating life of 10-15 years. The mining method would be stoping under rock fill (SURF) and long-hole, open-stoping. All crushing, grinding, and concentrating facilities, with the exception of final end-product processing, are proposed to be constructed underground. Access to the mine would be through a 10,000-ft-long (3,048 m) adit with 20-ft by 20-ft (6-m by 6-m) cross sectional dimensions. The adit portal would be located near tidewater, approximately two miles south of Juneau. Additional support facilities would be located adjacent to the portal. Tailings would be impounded behind a roller-compacted concrete hydroelectric dam located either in the Sheep Creek valley or adjacent valley. A 4.5 megawatt hydroelectric plant would be constructed near tidewater below the tailings dam. The U.S. Environmental Protection Agency has forcefully denied the alternative of marine disposal of the tailings.

ECHO BAY, with joint venture partner COEUR ALASKA INC. (a subsidiary of COEUR D'ALENE MINES) did more exploration drilling at the Kensington gold property near Berners Bay, 40 miles north of Juneau (loc. 25, fig. 6). The Kensington deposit occurs as quartz veins and stockworks in the Jurassic-Cretaceous Jualin diorite and trends roughly north-south for at least 820 ft (250 m). The zone is about 66-ft wide (20 m) and has downdip extensions for about 1,969 ft (600 m) (Kirkham, 1989). The 1989 drilling program, by BOYLES BROTHERS and WINK INTERNATIONAL, totaled 54,000 ft (16,460 m) for the year. During the previous year, a 2-1/2-mile (4 km) road was built by the joint venture from the beach, at the site of the old Comet mine property on Lynn Canal, midway between Haines and Juneau, to the Kensington portal site at the 800-ft-level (fig. 12). SOUTHCOAST completed driving the 15-ft by 20-ft exploration adit 5,400 ft (1,646 km), which intersected the main Kensington vein on the 850-ft-level. Assays indicated that the vein system contains 60 ft (18 m) of minable ore at about 0.18 oz/ton (6.1 g/tonne) gold with about 20 ft (6 m) of marginal ore on either side.

The exploration adit confirmed the continuation of the ore zone, which was defined at the 2,050-ft-level in a drilling program conducted by the previous owner, PLACID OIL. A small sawmill was set up by local logger-miner, BEAR VALLEY, and finished lumber was produced for the operation. The Kensington ore zone remains open along strike to the south and at depth. ECHO BAY will continue drilling in 1990 to delineate the vein system. A several hundred ton bulk sample was shipped to the LAKEFIELD LABORATORY in Lakefield, Ontario for metallurgical testing.

The Kensington ore is unique among Juneau Gold Belt deposits as it contains telluride minerals which require more complex recovery methods. Announced reserves of the Kensington were 8.4 million tons (7.6 million tonnes), grading 0.154 oz/ton (5.2 g/tonne) gold. Exploration work at the property in 1990 will include completing the raise to connect the two mine levels.

The mining method envisioned would be a long-hole open-stoping method with underground crushing and grinding. The tailings dam will cover 180 acres (73 hm^2) and reach a height of 239 ft (73 m). A commercial air strip may be constructed in 1990. The work force of approximately 350 will be housed on site. There will be 17.5 MW of installed diesel power. The annual payroll will be about $20 million. The company will complete feasibility studies and determine key development alternatives.

ECHO BAY is conducting baseline environmental studies for the potential mine at the Kensington and has started a technical feasibility study with the aid of the DAVY MCKEE CORP. The timetable for the feasibility analysis calls for the work to be completed for

presentation to both boards (ECHO BAY and COEUR D'ALENE) by early 1991.

ECHO BAY has combined management staff into a single centrally located office for both the A-J and the Kensington projects. They joined with the GREENS CREEK MINING COMPANY and the University of Alaska Southeast in sponsoring the Mine Safety Training Program to qualify area residents for the growing number of underground mining jobs in the Juneau area.

Additional exploration work was done at the Jualin mine property by PLACER DOME U.S., INC. The property is owned by HYAK MINING CO. of Juneau (loc. 26, fig. 6). PLACER is earning an operating interest from CURATOR AMERICAN, who owned 60 percent in 1989, and from GRANGES, who owned 40 percent. PLACER can earn 50 percent interest in the project. The Jualin gold deposit, like the nearby Kensington system, is a Jualin diorite-hosted auriferous vein system with past production of about 70,000 tons (63,504 tonnes) grading 0.56 oz/ton (19.1 g/tonne) gold (Barnett, 1989).

During 1989, PLACER drilled 20 holes for a total of 20,300 ft (6,187 m); most were drilled on the Jualin shear zone (fig. 13). Proven and probable reserves amount to about 1 million tons (907,000 tonnes) grading 0.309 oz/ton (10.5 g/tonne) gold. Improvements were made to the float ramp and the camp. The 5 mile road from Berners Bay to the campsite was completed the previous year (fig. 14).

PLACER was also active on the Dream prospect, drilling six holes totaling a little more than 7,000 ft (2,135 m). The Dream is interpreted to be a Kuroko-like massive sulfide deposit hosted in metavolcanics and sediments of Triassic age. The exploration program at the Dream is expected to double in 1990. Some geophysical work is also scheduled in 1990.

Figure 12. *Mine layout at the portal of the Kensington project, Echo Bay Exploration. Photograph by T.K. Bundtzen, 1989.*

PLACER did other reconnaissance work in a number of different projects in the Juneau Gold Belt, near Haines, and on Prince of Wales Island.

The Juneau City and Borough passed a series of changes to the local mining ordinance which serves as a severe disincentive for any individual prospectors or small companies doing serious exploration activity within the borough boundaries, which covers most of the Juneau Gold Belt.

Several small Juneau companies and prospectors were active during 1989. DALE HENKINS was active on the Sweetheart Ridge claims, Gold Fork, Grizzly Bar, Race-Lowell, Treadwell Beach, and the Crystal claims. ROGER EICHMAN was active on the E. Pluribus Unum, Lady Luck, and the Bessie claims. HYAK MINING CO. (HYAK) continued exploration for precious metal prospects on Lions Head, on the Enterprise River south of Taku Inlet, on the east shore of Lynn Canal, and on Douglas Island. HYAK leased the Red Diamond prospect on South Douglas Island to HECLA MINING CO. (HECLA).

NEWMONT EXPLORATION conducted metallic exploration programs throughout southeast Alaska, concentrating on nearshore vicinities in the Haines and Ketchikan areas. In 1987 and 1988, the company drilled and evaluated the Glacier Creek and "Boulder Patch" zinc-silver-barite massive sulfide deposits near Haines. GRANGES drilled four holes into the "Boulder Patch" prospect on Mt. Henry Clay in 1989 after taking over NEWMONT's lease.

GREENS CREEK MINING COMPANY drilled, sampled, and mapped the Hi East and West, Mammoth, Mariposite, Little Sore, and Fowler claims adjacent to the Greens Creek ore bodies which are now being exploited (loc. 27, fig. 6).

SEALASKA CORPORATION searched for gold, copper, and base metals in the Dolomi area of the Ketchikan mining district.

LAC MINERALS and joint venture partner NORANDA EXPLORATION INC. explored the Niblack, Ruby Tuesday, and Kaigoni base metal-precious metal properties on Prince of Wales Island (loc. 28, fig. 6), but at levels below

Figure 13. *Placer Dome U.S. drill rig at the Jualin mine property, Berners Bay. Photograph by T.K. Bundtzen, 1989.*

Figure 14. *Drill core showing auriferous tensional structure (857-862) that is oblique to the Jualin shear zone. Photograph by T.K. Bundtzen, 1989.*

those established in previous years. The Niblack Anchorage copper-zinc-gold deposit is a volcanogenic massive sulfide deposit localized near the boundary between the Late Precambrian to Cambrian Wales group, and Ordovician to Silurian Descon Formation (Brewer, 1989). Drill intercepts of up to 20 ft (6 m) grading 4.9 percent copper, 8 percent zinc, and 0.27 oz/ton (9.2 g/tonne) gold have been encountered on the property. PULSAR RESOURCES, a wholly owned subsidiary of HYDER GOLD CORPORATION, began exploring nine separate claim blocks in the Hyder area (loc. 29, fig. 6) near the southern tip of the Panhandle, focusing on gold targets. This area is near recently reopened mines in adjacent British Columbia, Canada.

KENNECOTT CORPORATION conducted exploration activities in the Nevada Creek area and at the Alaska Treasure claim group. ANTILLES RESOURCES LTD. worked in the Smugglers Bay area. ANDROMEDA RESOURCES explored in the Mirror Harbor vicinity. FMC GOLD was active at the Treasure Hill properties.

MINERAL DEVELOPMENT DURING 1989

INTRODUCTION

Mineral development expenditures declined to $134.3 million in 1989 from an all-time high in 1988 of $274.9 million (table 5). The decline was because of the conversion of the Greens Creek mine from a development mode in 1988 to a production mode beginning in February, 1989, and to the transition of the large Red Dog project into a production mode in November, 1989. The Red Dog mine will be predominantly a zinc producer, while the values of the base and precious metals at the Greens Creek mine are approximately equal.

Several major projects in the state are in advanced exploration stages. Some have already begun feasibility studies or the permitting process; but, as yet, none are firmly committed to production. It seems likely that the decline in development expenditures will continue in 1990, because for the purposes of this report, only those expenditures made after a production decision has been made are tabulated as developmental.

Many operating placer mines actually conduct development in the course of operations. Activities such as pond and road construction, or stripping to thaw the overburden and pay gravel are considered as development, but the costs of these activities are only included in this section if reported as development by the owner.

Canadian mineral-related activities that specifically affect the Alaskan economy are also described in this section. These activities include exploration, development, and production, since they all affect the Alaskan economy in the same way.

As in past annual reports, the selected development projects are discussed in relation to the seven geographical divisions of the state shown in figure 15.

RED DOG MINE, NORTHERN REGION

Construction of the mine and millsite facilities (see front cover), construction and assembly of the port facilities and port conveyor, and the preproduction stripping of the ore body at the Red Dog mine resulted in employment that ranged from 100 to 900 people during the 1989 construction season (table 6; loc. 1, fig. 15).

Major contractors for the Red Dog project included: VECO, GREEN CONSTRUCTION, PACIFIC CONSTRUCTION, NANA-MARRIOTT, R.M. PARSONS, OSBORNE, and MKB.

At the dock facility the third and final piling "cell" was completed in 1989 (fig. 16). Each cell consists of 18-inch-wide (0.5 m), 80-ft-long (24 m) interlocking steel piles installed around the 74-ft-diameter (22.5 m) cell, backfilled with 7,000-yd^3 (5,352-m^3) of shot rock. These cells support the conveyor system that will load concentrates on to barges from the huge concentrate storage building onshore. Measuring 1,425-ft (434 m), and 11-stories-high, with a 816,000-ton-capacity (740,275 tonne), the concentrate storage facility is the largest single building in Alaska (fig. 17). The dock, loading, and port facility are part of the De Long Mountain Transportation System, financed by $175 million in bonds issued by the Alaska Industrial Development and Export Authority, a state agency. Another major component of the transportation system is the 52 mile (83 km) haul road from the port to the mine site (loc. 2, fig. 15).

Nine mill modules arrived at the mine in the summer of 1989, after a sea journey from the Philippines via Dutch Harbor. This major sea lift also included 30,000 tons (27,216 tonnes) of supplies and 8 million gallons (30.3 million liters) of fuel.

By late October 1989, all of the components of the project were in place, and thanks to innovative and intensive training by MTS INTERNATIONAL and others, the workforce was able to begin tune-up

Table 5. *Mineral-development expenditures in Alaska by commodity, 1983-89*

	1983	1984	1985	1986	1987	1988	1989
Base metals	$19,500,000	$10,710,500	$13,000,000	$7,260,800	$62,080,000	$200,000,000	$118,200,000
Precious metals	7,112,500	15,058,555	16,890,755	16,417,172	37,640,848	74,945,400	6,876,350
Industrial minerals	1,000,000	579,000	1,830,000	124,000	188,000	--	7,000,000
Coal and peat	250,000	27,000,000	2,400,000	530,000	342,000	--	2,196,000
TOTAL	$27,862,500	$53,348,055	$34,120,755	$24,331,972	$100,250,848	$274,945,400	$134,272,350

-- = No expenditures reported.

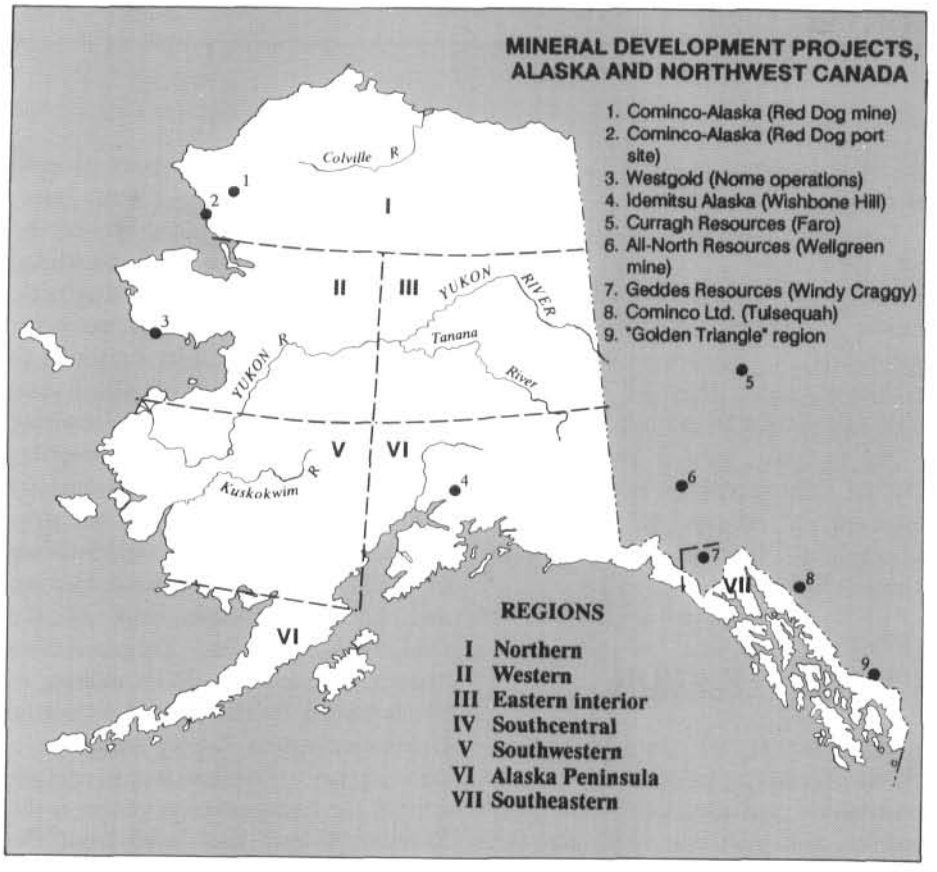


Figure 15. *Selected mineral development projects in Alaska and northwest Canada, 1989.*

Figure 16. *Open-cell sheet-steel-pile docking facility under construction at the Red Dog port site near Kivilina, Alaska. Photograph courtesy of Cominco-Alaska Inc., 1989.*

operations. Preproduction stripping began in August 1989, and milling operations started in November (fig. 18). The official opening of the mine is scheduled for August 1990, when concentrates begin being shipped to processing facilities.

When in full production the Red Dog mine is expected to produce 560,000 tons-per-year (508,032 tonnes) of zinc concentrate, 120,000 tons-per-year (108,864 tonnes) of lead concentrate, and 50,000 tons-per-year (45,360 tonnes) of bulk concentrate from 2.1 million tons-per-year (1.9 million tonnes) of mined ore. The 1990 production is expected to reach 440,000 tons (399,168 tonnes) of mainly zinc concentrate.

Open-pit mining methods will be used to mine about 5,000 tons-per-day (4,536 tonnes), initially, increasing to about 6,000 tons-per-day (5,443 tonnes) within three years. The anticipated stripping ratio over the life of the mine is expected to be less than 1:1. The mining equipment will include: four 85-ton haul trucks, two 13-yd^3 loaders, two

Figure 17. *Workers constructing the concentrate storage facility, Red Dog project. Photograph courtesy of Cominco-Alaska, Inc., 1989.*

bulldozers, one utility loader, one grader, and a water/sand truck.

The ore will be hauled less than half a mile to the primary crusher, and about 2,000 tons-per-day (1,814 tonnes) of concentrate will be produced after crushing, grinding, flotation, and dewatering.

A fleet of six 72-ton trucks will haul the concentrate 52 miles (83 km) over the state road to the concentrate storage shed at the port, which is about 15 miles (24 km) south of Kivalina. The concentrates will be loaded on to a conveyor at a rate of 2,000 tons-per-hour (1,814 tonnes) during the approximately 100-day ice-free shipping season, to be lightered by barges out to deeper water for transfer to ships with 25,000- to 60,000-ton (22,680- to 54,432-tonne) capacities.

About 50 percent of the concentrates will be shipped to the COMINCO smelter at Trail, British Columbia, and the remainder will be smelted in Europe and the Far East. During the year nine separate contracted companies provided 909 jobs; however some workers held several positions during the construction phase (table 6).

The open-pit mine is reported to be operating as expected, and realignment of one of the semi-autogenous grinding units will permit a return to full-scale operations. Oxidized ore in one of the upper benches is causing problems with the lead and silver metallurgy, but the zinc recovery is reported to be good. Some disruptions of transport to the port site have been caused by inclement weather, but overall, the operations are proceeding as expected.

WESTGOLD DOCK AND DREDGE DEVELOPMENTS, WESTERN REGION

WESTGOLD, operator of the offshore mining vessel Bima, constructed a modern open-cell dock off of the Nome Causeway, to stage summer operational assistance to the Bima and provide winter dredge moorage functions (loc. 3, fig. 15).

PERATROVICH, NOTTINGHAM, & DRAGE INC. provided design services to WESTGOLD. UNDERWATER CONSTRUCTION INC. of Anchorage was retained to build the dock, and backfill was provided by MARTINSON GRAVEL & CRANE INC. of Nome. The dock, filled with earth and rock, is designed to accommodate large load factors related to winter dredge emplacement, cranes, and fork lifts, and to withstand the erosive focus of the seasonal storms that frequently hit the Nome Causeway.

WESTGOLD continued the Nome Expansion Project (NEP) that is testing several dredging technologies (see back cover) in anticipation of expanding operations in new state and federal waters. Two types of extraction technologies are under review: bucket wheel and suction hose, both which can

Figure 18. *Preproduction stripping at the Red Dog mine site. Photograph courtesy of Cominco-Alaska Inc., 1989.*

Table 6. *Red Dog construction project employment summary, 1989*[a]

Company	NANA residents	All others	Total
Veco	23	84	107
Osborne	8	24	32
NANA/Marriott	28	8	36
Garco	2	6	8
Rockford	4	4	8
Green Construction	28	60	88
NANA/Veco	51	292	343
R.M. Parsons	1	42	43
Others	0	10	10
AIDEA	0	2	2
Cominco-Alaska	128	104	232
TOTAL	273	636	909

[a]Data provided by Cominco-Alaska, Inc.

Figure 19. *A crab-pot catch; part of Westgold's biological investigations of King crab populations off Nome, western Alaska. Photograph courtesy of Westgold, 1989.*

be designed for operating in water deeper than 65 ft (20 m). Dredge design modifications are forthcoming in 1990 or 1991. The company conducted detailed environmental studies during development of present and future offshore mining plans (fig. 19).

OTHER PLACER PROJECTS STATEWIDE

Placer development projects took place throughout all seven regions of Alaska (table 7). In the northern region MICK & CECELIA MANNS CO. was active on Flat Creek in the Wiseman area, crosscutting and stripping ahead of production. MASCOT MINING successfully diverted the Hammond River through their old mine area for approximately 1,000 ft (304 m) in preparation to mine adjacent gravels.

In western Alaska, as in past years, gold was the target of most mining activity and development focussed on the onshore dredging operations of ALASKA GOLD CO. and the offshore dredge of WESTGOLD. ALASKA GOLD CO. continued to develop reserves ahead of dredges #5 and #6, drilling about 210,000 ft (64,008 m) of thaw field holes to set the cold-water thaw-points. BERG & WETLESEN were stripping ground at Mud Creek in 1989, and making improvements to the airfield on the Seward Peninsula in the western region. GHD RESOURCES stripped ground and constructed roads at their Kiwalik Flats mine site near Candle. JOEL RAMSTAD stripped the lower end of Golden Creek in the Melozitna district.

Numerous operators were active in the Eastern Interior. Many companies reported stripping frozen overburden, silt, and barren gravel from pay gravel in advance of mining (fig. 20). Additional conversion to recycling mine process waters was a major expense. GHD RESOURCES was active on Eagle Creek, stripping 75,000-yd^3 (57,345-m^3) to pay gravels. Companies in the eastern interior that declared stripping and water recycling as major development expenditures of their mines include: LAST CHANCE MINING on Pearl Creek; HEFLINGER MINING & EQUIPMENT CO.; 45 PUP MINING near Eagle; THANKSGIVING MINING on Slate Creek; POLAR MINING, and C.W. CLEVELAND on the North Fork of Harrison Creek; KELLY MINING; and COOKS MINING. THANKSGIVING MINING also reported some ditch work; C.W. CLEVELAND repaired their mine road; and BTW MINING & EXPLORATION GROUP constructed a trail to their mine on Specimen Creek in the Mt. Hayes B-5 Quadrangle.

In southwestern Alaska, R.A. HANSON CO. INC. built a new classifier to handle clay material, fabricated buildings, and began an adit at their operation near Platinum. Near the Innoko River, the LITTLE CREEK MINE prepared ponds, ditches, and stripped ground for thawing.

The largest placer operation in the southcentral district is the Denali mine of the VALDEZ CREEK MINING COMPANY (VCMC). VCMC completed over 31,000 ft (9,451 m) of rotary drilling as part of their pit

development, and about 210,000 ft (64,024 m) of blasthole drilling.

Further development will require the diversion of Valdez Creek, and a decision to proceed is expected early in 1990. VALDEZ CREEK MINING COMPANY is 51 percent owned by CAMINDEX MINES LTD., which in turn is 91 percent owned by MVP CAPITAL CORP. Other participants are CAMBIOR INC. (25.875 percent), and AMERICAN BARRICK RESOURCES CORP. (23.125 percent).

Nearby ROWALLAN MINING readied a large placer reserve for production about 3 miles (5 km) above the VCMC operation. ROWALLAN reported plant set-up activities, classifying studies, and road work.

ARNOLD & SALLY ECHOLA worked on Gold Creek and Wickersham Creek west of the Denali mine and stripped ground ahead of their small placer mine pit.

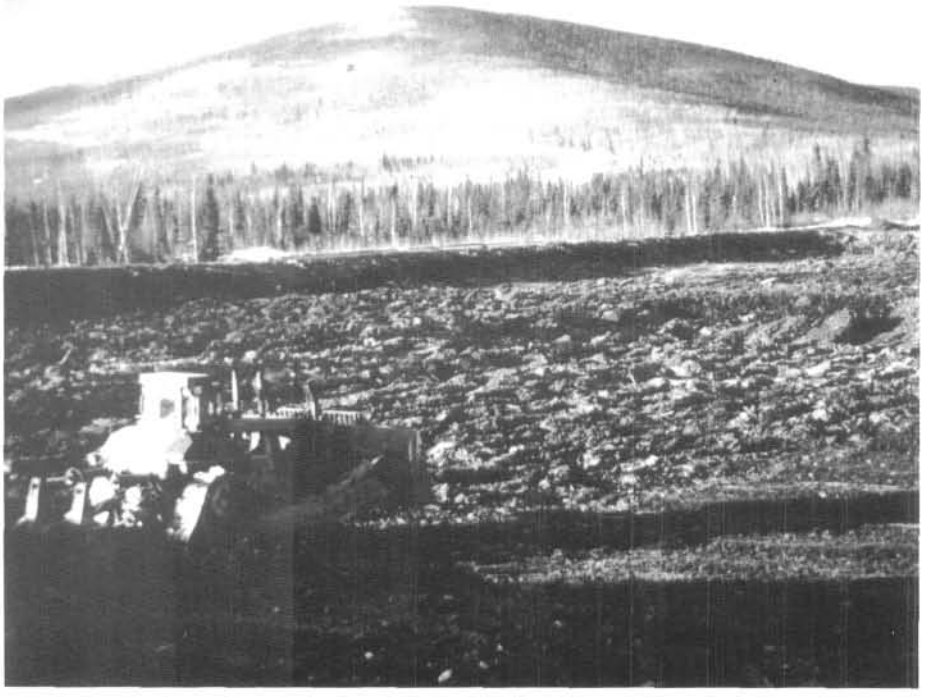


Figure 20. *Polar Mining, Inc. winter stripping operations on Sheep Creek, Fairbanks district. Photograph by T.K. Bundtzen, 1989.*

COAL PROJECTS

Coal development projects greatly accelerated from previously inactive years. USIBELLI COAL MINE, INC., continued exploration and development in the Hoseanna Creek area of their leases. An additional 200 million tons (180 million tonnes) of coal, over 100 years of reserves at current production rates, have been identified, and the baseline studies for the permitting process have been initiated. The proposed Healy Cogeneration project for environmentally clean generation of power, and the associated coal drying facility are discussed in the Coal Production section.

Another coal project entering the permitting stage in 1989 was the Wishbone Hill project of IDEMITSU ALASKA INC., a subsidiary of IDEMITSU KOSAN CO. (loc. 4, fig. 15). IDEMITSU KOSAN is the largest independent oil company in Japan, and is actively involved in coal development and mining activities worldwide. In order to take advantage of a window of opportunity, all permits for the Wishbone Hill project are needed by September 1990; mining will begin in late 1991. Current plans call for a workforce of 210, with an annual payroll of $10 million, producing about 1.1 million tons (1 million tonnes) of coal each year for shipment through Seward to Japan. Governor Steve Cowper announced in February 1990, his intent to seek funding from the legislature for additional locomotives and rail cars for the Alaska Railroad to facilitate coal shipments.

Table 7. *Reported placer development expenditures in Alaska by region, 1989*

Region	Number of operators	Expenditures
Northern	2	$ 255,000
Western	4	3,950,000
Eastern interior	9	342,450
Southcentral	5	1,217,000
Southwestern	2	700,000
Southeastern/Alaska Peninsula	2	83,500
TOTAL	24	$6,547,950

NORTHWEST CANADA MINERAL DEVELOPMENTS THAT AFFECT ALASKA

There are a number of mines and properties in the advanced exploration or development stages, in both the Yukon Territory, and British Columbia, that could ship material through Alaska. In previous years Canadian mining activity has been discussed in separate sections for exploration and development. Because

all of these activities can have a significant impact if Alaska is used as the base of operations, and because the difference between the various activities is seldom clear-cut, both types of Canadian activity are included in this section.

The Wellgreen polymetallic sulphide deposit, near Burwash Landing, contains promising values of nickel, copper, platinum, palladium, cobalt, gold, and the rarer platinum group metals according to a preliminary feasibility study (loc. 6; fig. 15). A 10,000 ton-per-day (9,072 tonne) open-pit operation is envisioned, which would produce about 10,000 tons-per-year (9,072 tonnes) of nickel, the same amount of copper, 25,000 ounces (778 kg) of palladium, and 37,000 ounces (1,151 kg) of platinum annually. Probable resources were estimated to be 46.6 million tons (42.3 million tonnes). Further resources are inferred on the property which is owned by ALL-NORTH RESOURCES LTD., 59 percent owned by GALACTIC RESOURCES LTD. The closest tidewater port to the Wellgreen deposit is Haines.

Haines might also serve as the port for loading concentrates from the Windy Craggy copper-zinc-gold-cobalt deposit located on the Tatshenshini River approximately 70 miles (112 km) west-northwest of Haines (loc. 7; fig. 15). Approximately $30 million has been spent to define more than 165 million tons (150 million tonnes) of ore, 75 percent of this in the probable category, and the rest in the possible category, containing an average of 1.9 percent copper. A further expenditure of about $10 million in 1990 is expected to move at least 39 million tons (35 million tonnes) into the proven category to assure feed for the first five years of mining, which could begin as early as the end of 1992.

The estimated in-place metal content is about 930,000 ounces (28,926 kg) of gold, 14.8 million ounces (460,342 kg) of silver, 300 million pounds (136 million kg) of cobalt, and 5.5 billion pounds (2.49 billion kg) of copper. At a mining rate of 22,040 tons-per-day (20,000 tonnes) one plan anticipates that about 495,000 wet tons (450,000 tonnes) of concentrate each year, containing 132,000 tons (120,000 tonnes) of copper, would be trucked 160 miles (257 km) to Haines, requiring about one truck every hour. The project remains in an advanced exploration stage but no development decisions have been made.

Further south, 40 miles (64 km) east of Juneau and just inside the Canadian border, COMINCO LTD. and junior partner REDFERN RESOURCES LTD. continued with exploration of the Tulsequah Chief mine, and confirmed the mineralization to a depth of 1,600 ft (488 m) below the lowest existing mine level (loc. 8, fig. 15). REDFERN president John Greig indicates that the individual lenses coalesce at depth, and form a continuous sheet of mineralization which is presently open on all sides, and which contains better mineral values than is found higher in the mine. The 1989 drill program has expanded reserves to 6.4 million tons (5.8 million tonnes) grading 7.0 percent zinc, 1.6 percent copper, 1.3 percent lead, 2.93 oz/ton (100 g/tonne) silver and 0.08 oz/ton (2.7 g/tonne) gold. A 600 ft (183 m) extension of the 5,400-ft-level drift is planned for 1990 to allow deeper drilling.

Across the Taku River from the Tulsequah Chief, SUNTAC MINERALS CORP. and REMBRANDT GOLD MINES also drilled below the known mineralization at their Polaris-Taku mine.

About 40 miles (64 km) inland from Wrangell, the pace of exploration became frantic in 1989 in the Iskut River-Eskay Creek area of British Columbia (loc. 9, fig. 15). PRIME RESOURCES, by virtue of its control over CALPINE RESOURCES, became the 50 percent owner of the Eskay Creek property, owned jointly with CONSOLIDATED STIKINE SILVER LTD. A 682-ft (208 m) intercept in one drill hole averaged 0.875 oz/ton (30 g/tonne) gold with significant zinc, lead, and silver. Probable reserves for the "21 Zone" as of February, 1990 are 1.38 million tons (1.25 million tonnes) with 1.52 oz/ton (52 g/tonne) gold, and 38.0 oz/ton (1,302 g/tonne) silver, with a further 481,000 tons (437,000 tonnes) of possible reserves grading 0.88 oz/ton (30 g/tonne) gold, and 32.8 oz/ton (1,124 g/tonne) silver.

Several properties in the so-called "Golden Triangle" are classed as being in the development stage by the British Columbia Geological Survey Branch. The Snip property, owned by COMINCO LTD. and PRIME RESOURCES, has reserves of 1.03 million tons (936,000 tonnes) grading 0.91 oz/ton (31 g/tonne) gold, while the Goldwedge property of CATEAR RESOURCES LTD. contains 319,000 (290,000 tonnes) grading 0.79 oz/ton (27 g/tonne) gold, and 6.92 oz/ton (237 g/tonne) silver. NEWHAWK GOLD MINES LTD. and GRANDUC MINES LTD. are joint owners of the Sulphurets property, which has reserves of 848,000 tons (770,000 tonnes) grading 0.36 oz/ton (12 g/tonne) gold, and 23.6 oz/ton (809 g/tonne) silver. At the Kerr property of WESTERN CANADIAN MINING and PLACER DOME INC. inferred reserves are 125 million tons (114 million tonnes) averaging 0.61 percent copper, 0.05 oz/ton (1.7 g/tonne) silver, and 0.008 oz/ton (.27 g/tonne) gold (loc. 9, fig. 15).

MINERAL PRODUCTION ACTIVITY IN 1989

INTRODUCTION

The value of mineral production in 1989 was $277 million, an increase of 19 percent from the $232 million recorded for 1988, and 37 percent more than the $202 million produced in 1987 (table 8). Production quantities, gross values, and relative percentages were: (1) gold--284,617 ounces (8,852 kg) worth $108.7 million, and 39 percent; (2) coal--1.45 million tons (1.32 million tonnes) worth $41.5 million, and 15 percent; (3) sand-and-gravel--14.4 million tons (13.1 million tonnes) worth $39.9 million, and 14.4 percent; (4) zinc--19,843 tons (18,007 tonnes) worth $29.4 million, and 10.6 percent; (5) silver--5,211,591 ounces (162,108 kg) worth $27.3 million, and 9.9 percent; (6) building stone--2.8 million tons (2.6 million tonnes) worth $20.3 million, and 7.3 percent; (7) lead --9,585 tons (8,698 tonnes) worth $7.7 million, and 2.8 percent; and all other commodities--jade, tin, platinum, and peat were worth $2.2 million, and 0.8 percent of total value.

Metal production dominated 1989 production, accounting for 63 percent of the total product value. Coal, industrial minerals, jade, and peat made up the remaining 37 percent of product value. For the first time since the late 1930's, base metals (zinc, lead, tin) accounted for a significant percentage (13 percent) of Alaska mineral production. With the increases of zinc and lead concentrate shipments from the Greens Creek and Red Dog mines, total value of both base metals should increase in 1990. Principal metallic, nonmetallic, coal mine, and quarry locations are shown in figure 21.

Production estimates are based on data compiled from about 150 DGGS questionnaires returned by companies and individuals; responses from a telephone survey of 25 companies that mine sand-and-gravel, and two that quarry stone; production information provided by the Bureau of Land Management (BLM); the U.S. Army Corps of Engineers (COE); the Alaska Department of Transportation and Public Facilities (DOTPF); and precious metal refiners. Historical production for gold, sand-and-gravel, and coal are compiled in figures 22, 23, and 24, respectively. Production estimates dating from 1880 for nine metals, three industrial minerals, and coal (appendices E and F) show that Alaskan mineral production has been dominated by gold.

Despite the positive upward value of mineral production, there were significant shifts within individual industries, and some mine activities faced significant economic challenges. Sand-and-gravel and building stone showed the biggest losses, and decreased about 18 percent in both volume and value (table 8). These significant decreases reflect a weak Alaskan economy and the nearly complete lack of infrastructure development on Alaska's North Slope oil fields. Additionally, some major highway and military construction projects began to wind down in 1989.

Tin production dropped nearly 35 percent (from 136,116 kg in 1988 to 87,988 kg in 1989) because of the decrease in minable reserves at LOST RIVER MINING COMPANY's Cape Creek mine west of Nome. The property permanently ceased production at the end of the season, and tin production is expected to drop significantly in 1990.

Employment statistics still indicate that the dominant employer is the placer gold mining industry--the largest employer for all of the 1980's.

The Department of Natural Resources (DGGS and DOM) survey results show that an estimated 284,617 ounces (8,852 kg) of gold and 5,211,591 ounces (162,102 kg) of silver were recovered from 217 placer mines and five lode mines (table 9). This is a 7 percent increase in gold quantity, and the Greens Creek mine brought a hundred fold silver increase over that produced in 1988. The gold production is the highest in 39 years (since 1950) and the silver production is the highest in history. From 1911 to 1938, silver production ranged from 0.7 to 1 million ounces (21,700 to 31,100 kg) annually, mostly produced as a byproduct of copper mining by the KENNECOTT COPPER CORPORATION in the Chitina valley. With this major exception, Alaskan silver production has been a byproduct of placer and lode gold production. Consequently, the 1989 silver production marks a fundamental change in the dynamics of this segment of the industry. Silver production is expected to grow even more in 1990 with the marketing of substantial byproduct silver from the Red Dog zinc mine. In 1989, Alaska accounted for about 10 percent of the national production of silver.

The dynamics of the gold mining industry are as complicated as ever. Despite the 18 percent increase in volume from 1988, lower overall gold prices (1988 average: $422/oz; 1989 average: $382/oz) resulted in the value of production dropping 4 percent from 1988 to 1989. Virtually all the increase in the gold quantity is attributed to lode production at the Greens Creek mine, which produced 23,530 ounces (732 kg) of gold. The remaining placer and lode mines produced about the same amount of gold as in 1988. The 217 active placer mines in 1989 represent a net gain of 11 from the previous year. The 217 placer operations produced 247,948 ounces (7,712 kg), about 87 percent of total gold production, or an average of 1,143 ounces (35.5 kg) per operation. The average gold mine (lode and placer) produced 1,282 ounces (40 kg) per operation, compared to 1,276 ounces (39.7 kg) per operation in 1988.

Table 8. *Reported mineral production in Alaska 1987-89*[a]

Metals	Quantity			Estimated values[b]		
	1987	1988	1989	1987	1988	1989
Gold (ounces)	229,700	265,500	284,617	$104,516,230	$112,837,000	$108,723,694
(kilograms)	7,144	8,258	8,852			
Silver (ounces)	54,300	47,790	5,211,591	390,960	281,950	27,360,852
(kilograms)	1,688	1,486	162,102			
Platinum (ounces)	W	25	W	W	13,750	W
(grams)	W	777	W			
Lead (tons)	NR	NR	9,585	NR	NR	7,672,009
(tonnes)	NR	NR	8,698			
Zinc (tons)	NR	NR	19,843	NR	NR	29,383,386
(tonnes)	NR	NR	18,007			
Mercury (pounds)	NR	W	W	NR	W	W
(kilograms)	NR	W	W			
Tin (pounds)	288,000	300,000	194,000	460,000	950,000	672,000
(kilograms)	130,636	136,080	87,988			
Tungsten (short ton units)	160	240	NR	11,400	14,000	NR
(tonnes)	145	217	NR			
Subtotal				$105,378,590	$114,096,700	$173,811,941
Industrial minerals, coal and peat						
Jade and soapstone (tons)	3.6	W	57.0	$ 78,000	$ W	$ 1,140,000
(tonnes)	3.3	W	51.7			
Sand and gravel (million tons)	16.7	17.2	14.4	42,659,808	48,750,508	39,875,000
(million tonnes)	15.1	15.6	13.1			
Building stone (million tons)	1.8	3.6	2.9	11,620,000	24,650,000	20,340,000
(million tonnes)	1.6	3.3	2.6			
Subtotal				$ 54,357,808	$ 73,400,508	$ 61,355,000
Coal (tons)	1,508,927	1,551,162	1,452,353	$ 42,354,500	$ 44,300,000	$ 41,464,800
(tonnes)	1,368,898	1,407,214	1,317,574			
Peat (cubic yards)	46,000	55,000	51,000	299,000	375,000	352,000
(cubic meters)	35,171	42,053	38,995			
Subtotal				$ 42,653,500	$ 44,675,000	$ 41,816,800
TOTAL				$202,389,898	$232,172,208	$276,983,741

[a]Production data from DGGS questionnaires, phone interviews with mine operators, Alaska Department of Transportation and Public Facilities, the U.S. Army Corps of Engineers, and other confidential sources.

[b]Values calculated from 1989 annual price averages of gold, silver, platinum, zinc, and lead reported in the "Mining Journal"; other values supplied directly by mine operators. Coal-value estimates include some in-state freight costs.

NR = not reported; W = withheld.

Total employment attributed to precious metal mines was 1,477 or 6.6 per mine, compared to 7.5 in 1988 (table 10). Larger operations account for an increasingly higher percentage of gold output--a consistent trend for the last four years. Alaska's largest lode and placer gold producing companies in descending order are: VALDEZ CREEK MINING COMPANY; WESTGOLD; GREENS CREEK MINING COMPANY; ALASKA GOLD COMPANY; POLAR MINING; CITIGOLD ALASKA; WINDFALL MINING; LIVENGOOD PLACERS; GHD RESOURCES; and SPHINX AMERICA. The mines owned by these companies produced 174,470 ounces (5,426 kg) or 61 percent of total Alaska gold output. In 1988 Alaska's ten largest gold mines

accounted for 59 percent of the total statewide gold production.

Obviously, the small mining operations, even though increasing in number, generated a smaller percentage of the total gold product. The remaining 212 small gold mining operations produced 110,147 ounces (3,426 kg) or 520 ounces (16 kg) per operation and employed four people compared to average output and employment levels of 644 ounces (20 kg) of gold and 4.2 employees in 1988. This is a decrease in average small mine output of 19 percent. The production decrease also occurred in a year when the average price declined 10 percent. Because of these two factors, the average small-scale mechanized placer mine (based on average output and prices) grossed $198,640 in 1989 compared to $273,700 in 1988, a value difference of 27 percent between the two reporting years.

Several factors contributed to the decrease in production from the small mining firms. The U.S. Environmental Protection Agency (USEPA) began requiring 100 percent recycling of mine process water in 1989, which necessitated extensive mine plan revisions for a majority of small companies statewide. Cost of installation of new state-of-the-art recycling systems was estimated to average $25,000 by 25 companies and teething problems typical of new technology applications resulted in a lower volume of paydirt processed.

The resolution of the 1987 Sierra Club vs. Penfold lawsuit that limited mining on federal lands in the Fortymile River, Chatanika River, Birch Creek, and Beaver Creek drainages of interior Alaska mandated strict enforcement of 43CFR3809 land reclamation regulations on ground disturbed by mining since 1981. Also the Department of Natural Resources (DNR), DOM began to closely monitor reclamation under the provisions of the Miscellaneous Land Use Permit and other state regulations. Production time was lost as miners reclaimed land from previous seasons.

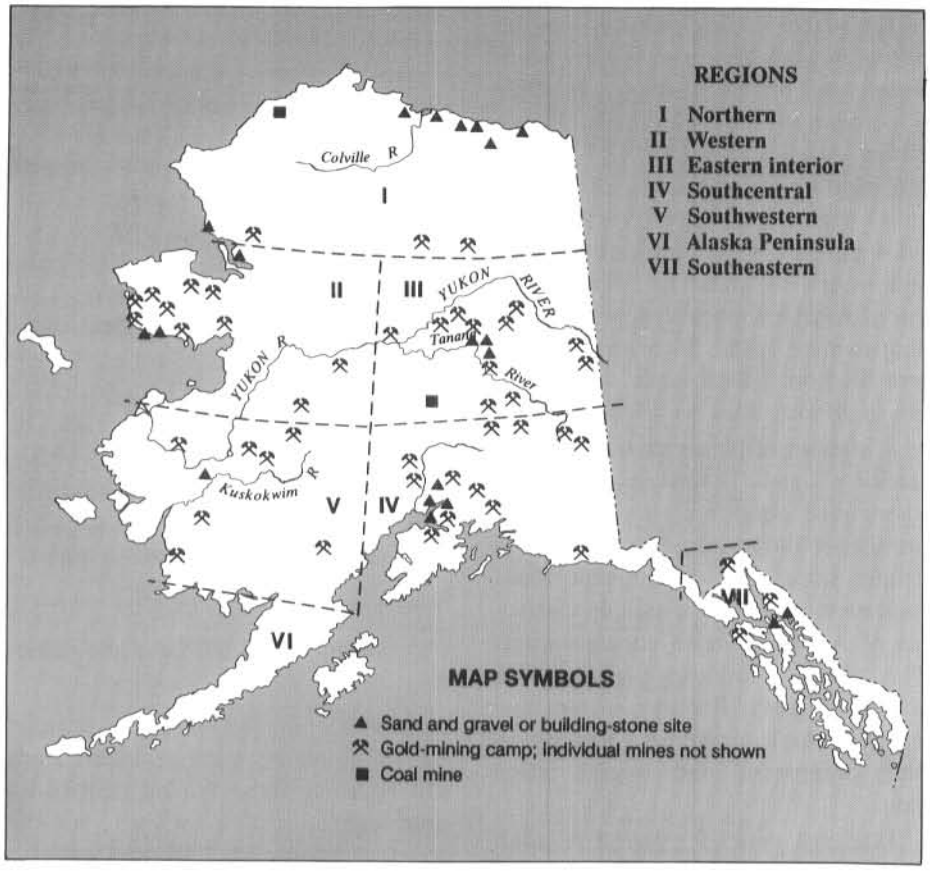


Figure 21. *Location of principal gold mining camps, coal mines, and industrial mineral sites in Alaska, 1989.*

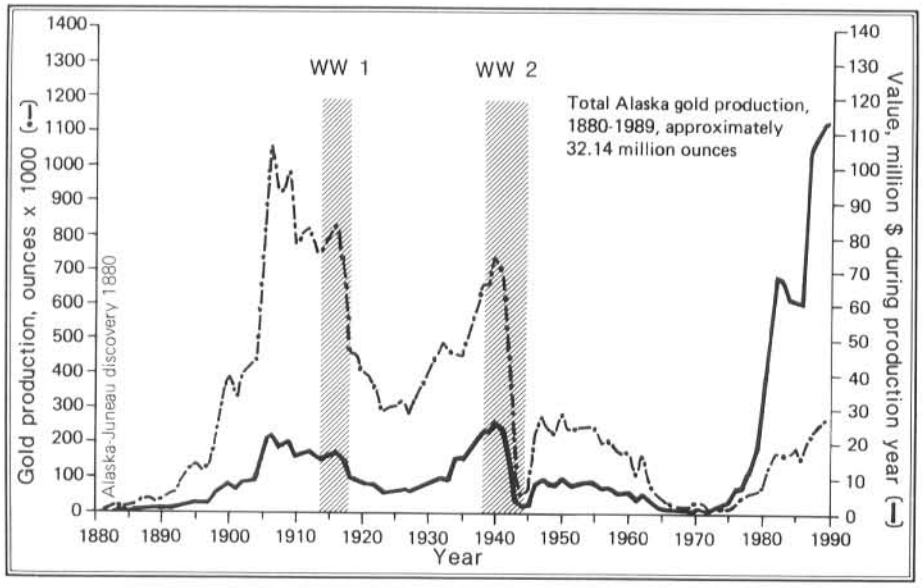


Figure 22. *Gold production in Alaska, 1880-1989.*

The placer mining industry may be shifting its activities from federal lands to state and private holdings. In 1986, 68 percent of the 512 Alaska Placer Mining Applications (APMA) or 348 were filed on federal lands; 28 percent or 143 applications were on state land; and 4 percent or 20 applications were filed on private lands. In 1989, 55 percent of APMA applications or 220 were filed on state lands; 38 percent or 153 were filed on federal lands; and 7 percent or 28 were filed on private lands.

A number of placer mining areas in interior and western Alaska experienced abnormally heavy rainfall throughout the season that resulted in serious flooding and frequent mine shutdowns. The Circle mining district, one of Alaska's largest concentrations of placer mines, experienced particularly heavy flooding in late June which resulted in extensive damage to mine equipment and overall mine plans.

Unit-cost data of selected Alaskan gold mines is summarized in table 11. This unit-cost data table represents company estimates of the cost to produce an ounce of gold during the 1989 operating season. The results show a wide range of costs, from $238/oz to $360/oz, with the overall average at $320/oz. Small to medium-sized mines are apparently the most economical on a unit-cost basis while the two lode operations surveyed were shown to be the least profitable. The 23 mines sampled represent about 10 percent of Alaska's gold mines and 39 percent of gold production, indicating that a disproportionate number of large operations provided the cost data.

Several significant legal or government actions influencing Alaska's mineral industry took place in 1989. In May, the Alaska legislature amended certain state laws governing the location of state mining claims, and implemented rental and royalty fees for all mining on state lands. This legislation was in response to the Alaska Supreme Court's decision that

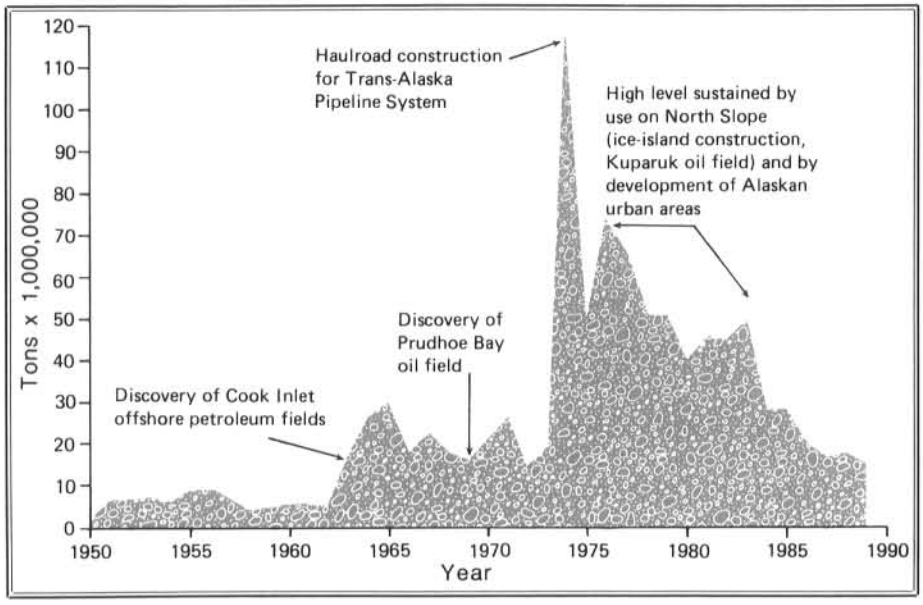


Figure 23. *Sand and gravel production in Alaska, 1950-89.*

section 6(i) of the Alaska Statehood Act required the state to collect rents and royalties from mining activity on state lands. The statute became effective August 31, 1989, and requires rent on mining claims, leasehold locations, and offshore mining leases on all state land. Annual rent is due on September 1, and must be paid by November 30 of each year. Rents begin at $20 for each mining claim and $0.50 per acre for each mining lease, and escalate through time. The DOM began drafting the regulation that will require the additional 3 percent net royalty payment from operating mines. Miners are currently required to pay an Alaska mining license tax on net income from mining activities on all Alaska lands, regardless of land status. This is in addition to net corporate income taxes.

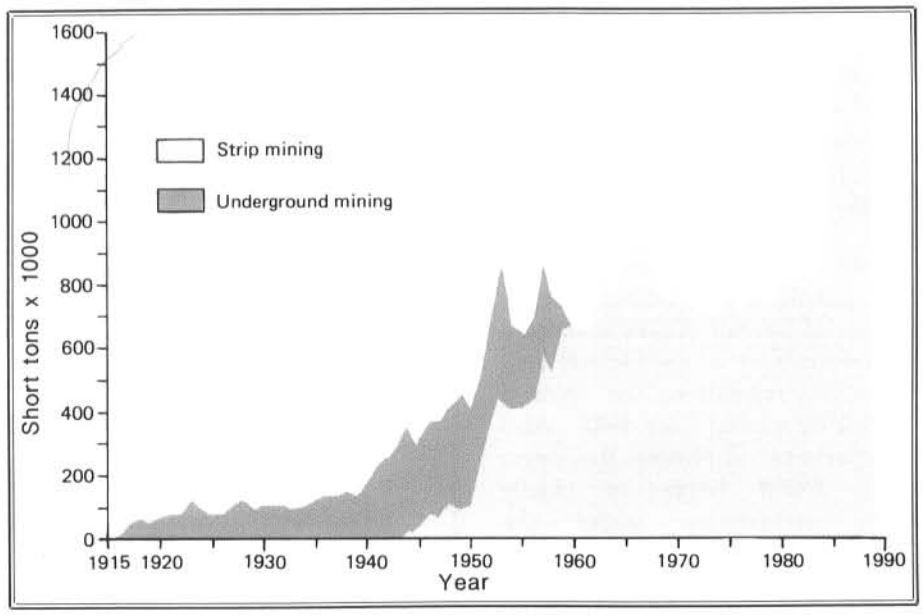


Figure 24. *Coal production in Alaska, 1915-89.*

Table 9. *Reported refined gold production, number of operators, and industry employment in Alaska by region and mining district, 1988-89*[a]

Region and mining district	1988 Number of operators	1988 Production (oz)	1988 Number of employees	1989 Number of operators	1989 Production (oz)	1989 Number of employees
Northern	8	6,500 (202 kg)	32	13	6,800 (211 kg)	38
Chandalar						
Shungnak						
Koyukuk-Nolan						
Western	48	98,500 (3,063 kg)	425	43	87,500 (2,721 kg)	437
Nome						
Koyukuk-Hughes						
Kougarok						
Port Clarence						
Fairhaven						
Ruby-Poorman						
Solomon						
Koyuk						
Council						
Eastern Interior	89	76,550 (2,381 kg)	415	115	79,300 (2,466 kg)	494
Circle						
Livengood-Tolovana						
Fairbanks						
Fortymile						
Manley-Eureka						
Richardson						
Bonnifield						
Rampart						
Southcentral	30	68,300 (2,124 kg)	315	21	73,100 (2,273 kg)	280
Cache Creek						
Chistochina						
Valdez Creek						
Kenai Peninsula						
Nelchina						
Southwestern	33	14,800 (460 kg)	108	26	13,950 (434 kg)	102
Innoko-Tolstoi						
Iditarod						
Moore Creek						
Nyac						
Crooked Creek						
Lake Clark-Mulchatna						
Southeastern and Alaska Peninsula	3	850 (26 kg)	10	4	24,967 (776 kg)	126[b]
TOTAL	211	265,500 (8,258 kg)	1,305	222	284,617 (8,852 kg)	1,477

[a] 1989 production estimated from 217 mechanized placer mines and five lode mines statewide. Small "recreational-assessment" projects that recover bullion by panning, pick-and-shovel prospecting, long-tom sluicing, and suction dredging are not included.

[b] Employment from Greens Creek mine totaled 243, but because half the production value from the mine comprises gold and silver, only half the employment figure is credited to the table.

Table 10. *Alaska mineral employment summary 1981-89*

	1981	1982	1983	1984	1985	1986	1987	1988	1989
Gold/silver mining									
Placer	1,250	1,950	2,000	1,700	1,505	1,155	1,197	1,206	1,316
Lode	85	51	6	0	35	2	52	99	161
Base metals	--	--	--	--	--	--	--	--	407
Recreational	1,500	700	--[b]	--[b]	--[b]	230	245	350	325
Sand and gravel	271	900[c]	1,200[c]	1,600	1,435	1,100	868	752	625
Building stone	40	--[b]	--[b]	185	200	225	185	210	158
Coal	85	90	95	115	115	125	127	122	115
Peat	15	--[b]	--[b]	--[b]	--[b]	60	--[b]	--[b]	--
Tin, jade, soapstone	30	34	35	75	60	55	55	40	35
Mineral development[a]	200	210	145	185	245	171	427	1,294	785
Mineral exploration	1,057	179	232	120	55	62	91	280	252
TOTAL	4,533	4,114	3,713	3,980	3,650	3,185	3,247	4,353	4,179

[a]Development and exploration employment not tabulated in 1981-86 annual reports.
[b]--means not calculated.
[c]Originally calculated on 12 month year; recalibrated on five month year to compare with 1984-88 statistics.

In response to the successful operation of the Bima dredge in State of Alaska waters, the U.S. Minerals Management Service (MMS) issued a draft environmental impact statement (DEIS) for a proposal to offer to lease about 147,000 acres (59,490 hm^2) of federal offshore lands on the continental shelf. The DEIS identified the potential for mercury bioaccumulation in the food chain within the Nome area. Mercury had previously been used to amalgamate gold during placer mining operations in the area, and sporadic test results had showed some high levels of the element. Because of fears generated by the potential problem, the MMS delayed the lease sale, and contracted Batelle Northwest to conduct extensive metal analyses of water discharge from the Bima dredge, and of human-hair samples collected from Nome residents. Results showed that neither the level of mercury in the discharge nor that in the hair samples exceeded established EPA standards. In fact, the first-year results show that levels of methylmercury in Nome residents are among the lowest of any indigenous coastal people in North America. The federal lease proposal is now expected to be completed in mid-1991, about 18 months behind the original 1989 schedule.

In related action, DNR issued a pre-lease evaluation, a "best interest finding," and the Division of Governmental Coordination (DGC) issued a "coastal consistency determination," regarding issuance of offshore prospecting permits within the state's 3-mile limit near Nome. Later in the year, additional state offshore leases were issued.

A clean-up of the port and docking facility metal contamination at Skagway was completed by CURRAGH RESOURCES, who ship lead-zinc-silver concentrates from the Anvil mine in central Yukon Territory. Past operators of Canada's largest zinc mine shipped sulfide concentrates from Skagway to several overseas buyers from 1969 to 1982, and CURRAGH resumed shipments in 1986. After CURRAGH and government agencies detected anomalous lead and zinc dust concentrations at the port, the loading facility was completely enclosed and other shipping infrastructure was modified at a cost of $4 million. Ongoing testing of Skagway residents for lead and zinc have failed to show anomalous levels in blood or tissue. In fact, 1989 results show that the Skagway residents, with two exceptions, had lead and other heavy metal levels that were significantly below the national average. Also in 1989, WHITE PASS TRANSPORTATION COMPANY, who formerly hauled concentrates from Whitehorse to Skagway via the White Pass Railroad, began to clean up the rail route using large air-suction units to collect the sulfide dust. Further cleanup work is planned for 1990.

Mining and other resource development projects may be adversely affected by the November 1989 signing of a Memorandum of Agreement (MOA) between the EPA and COE concerning requirements for obtaining wetlands development permits under the Federal Clean Water Act. The MOA states a goal of requiring acre for acre compensation for any unavoidable impact a development might cause; however, it also states the goal of achieving this "no-net-loss" policy on a permit-by-permit basis. Although 56 percent of all original wetlands have been disturbed in the "lower 48," Alaska has retained 99.95 percent of its original wetlands acreage. A one-

year postponement of the federal policy in Alaska was enacted by the Bush Administration late in the year.

DOM initiated a comprehensive airphoto survey of mining operations throughout mainland Alaska including those in the Fairbanks, Koyukuk-Nolan, Chandalar, Richardson, Fortymile, Iditarod, Innoko, Ruby-Poorman, Tolovana, Bonnifield, Circle, Rampart, Kantishna, Cache Creek, Chistochina, Chisana, and Valdez Creek districts. These photos could be valuable aids in the determination of wetland impacts and reclamation planning. Photos at a scale of 1" = 300' are available upon request from the DOM office in Fairbanks.

Table 11. *Costs of production for selected Alaskan gold mines, 1989*[a]

Mine type	Number of mines	Total recovered oz (gold)	Total mine costs (in $)	Unit cost (oz)
Small placer (50 - 650 oz gold/yr)	11	2,977	784,177	$263
Medium placer (650 - 2,500 oz gold/yr)	5	6,461	1,538,000	$238
Large placer (≥2,500 oz gold/yr)	5	98,816	31,972,300	$324
Lode mines	2	8,129	2,930,000	$360
All placer mines	21	108,254	34,294,477	$317
All gold mines	23	116,383	37,224,477	$320

[a]Data derived from confidential questionnaires and records provided by 23 Alaskan gold mining firms. Recreational mine ventures not included.

METALS

NORTHERN REGION

Some 32 National Pollution Discharge Elimination System (NPDES) permits were issued for mining in the northern region, and 13 companies actually operated placer mines. Although the number of mines increased by five, gold production, at 6,800 ounces (211 kg), was about the same as in 1988. The area was hard-hit by two summer floods, and six mining companies suffered severe mechanical difficulties. An additional six operations redesigned their plants in order to recycle mine process waters.

Those miners active in the Koyukuk-Nolan-Wiseman area include: DAN EVEN (Jim Pup) (fig. 25); the TOM BRYANT, SAM MUNGAR, and OVERTON JILES operations (Hammond River); BILL LIGHT (Nolan Creek); BOB AUMILLER (Prospect Creek); WILLIAM BELL (Boulder Creek); WILLIAM NORDEEN (Emma Creek); JIM SWAN (Gold Creek); GEORGE YODER (Sheep Creek); and GLENN BOUTON (Chapman Creek). OUTLAND RESOURCE GROUP began production on Chapman Creek near BOUTON's operation. PAUL DIONNE opened an exploration drift into a hillside placer on Nolan Creek during the winter of 1989-90 and found coarse nuggets up to 21 ounces while hand shoveling ore. ARVID EVLANDSON operated on a gravel bar off the Hammond River feeding a washing plant with a backhoe.

PARADISE VALLEY MINING INC. continued to operate a combined mechanized placer mine-tourist mine venture on Birch Creek, east of Wild Lake in the central Brooks Range; PARADISE indicated that "fighting floods" was the main activity during 1989.

TOBIN CREEK MINING CO. was busy again on Tobin Creek in the Chandalar district. Unfortunately, mine operator TOM WALKER died of a heart attack on Tobin Creek in late June, and operations for the rest of the year were drastically reduced in scope.

Figure 25. *Dan Even completing the first test cut on Jim Pup, a small steep creek approximately 18 miles east of Wiseman. Photograph by D. Even, 1989.*

A new operator, GOLD DUST MINES, is expected to begin working on Tobin Creek in 1990, with an anticipated capital investment of $2.5 million.

The JOHN SLATT-BALDWIN partnership operated a small scale placer mine on Weise Creek, a tributary to the Kobuk River, in the Ambler district of the western Brooks Range.

WESTERN REGION

Gold, silver, and tin were produced in reduced quantities by placer mines in the western region compared to 1987 and 1988. However, the region's mines continued to lead the state in production of gold and tin. An estimated 43 operators produced 87,500 ounces (2,721 kg) of gold; mining companies seasonally employed 437 people during the year. All metal production was derived from placer mines.

ALASKA GOLD COMPANY operated two bucketline stacker dredges, working onshore ancient strandline deposits near Nome, and recovered 21,000 ounces (653 kg) of gold. Dredge #5 operated near the base of Anvil Mountain on the third beach about 3 miles (5 km) northeast of Nome. Dredge #6 worked the western extension of the "submarine beach" approximately 1-1/2 miles (2-1/2 km) west of the Nome airport. Both dredges are Yuba-type double-hulled steel dredges with 9-ft^3 buckets. Dredge #5 has a daily capacity of 9,000-yd^3 (6,881-m^3) or 1,440,000-yd^3 (1,101,000-m^3) during the 160 day operating season. Dredge #6 has a daily capacity of 7,000-yd^3 (5,352-m^3) or 1,120,000-yd^3 (856,350-m^3) during the 160 day 1989 season.

WESTGOLD operated their offshore dredge Bima and recovered 30,661 ounces (953 kg) despite various mechanical problems and severe weather conditions (fig. 26). The 1989 product was 14 percent less than the 1988 total of 35,500 ounces (1,104 kg).

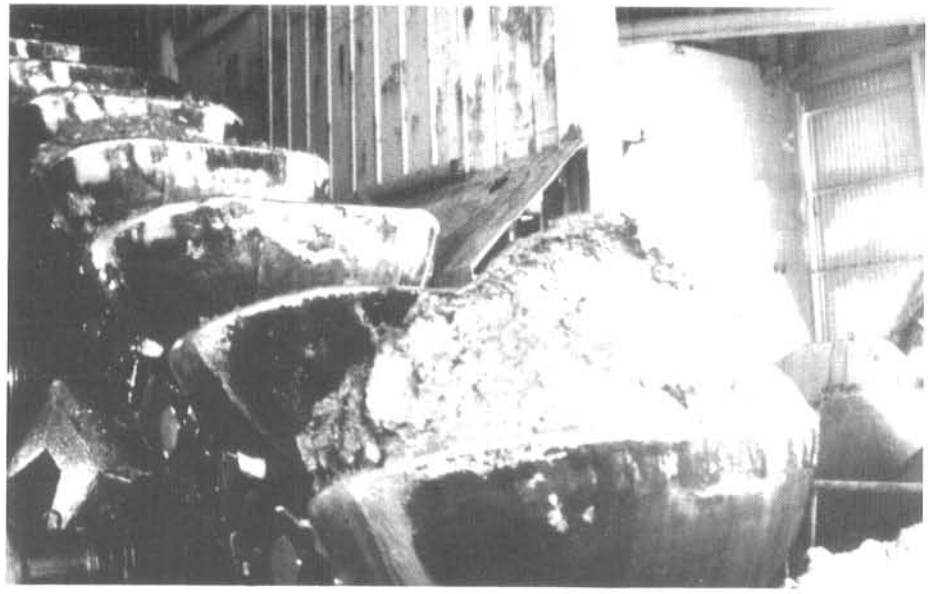


Figure 26. *Bima bucketline at work, off Nome, western Alaska. Photograph courtesy of Westgold, 1989.*

The lower idler of the enormous 134-bucket ladder assembly failed in June, causing the 1.1 yd^3 (.85-m^3) capacity buckets to cease digging operations. The mechanical failure was responsible for a 24-day shutdown period early in the season.

In November 1989, winter shelf ice formed along the Nome Causeway and prevented the dredge from being secured for winter storage. This problem required an ice breaking effort to provide open water passage to the causeway mooring facility; fortunately the ice-bound dredge was not damaged. The 1989 season began on June 9 and ended on November 11, with 110 days of actual production (Peterson, 1990). The company employed 128 people in 1988 and 1989 including: 110 Alaska hired and 18 out-of-state workers (Rusanowski, 1990).

WINDFALL MINING COMPANY completed a 5-year program on ground leased from ALASKA GOLD COMPANY in the old USSR&M Dredge #1 (Wonder Creek and Cooper Gulch) area north of Nome. The company produced 5,450 ounces (169 kg) of raw gold and reported a substantial loss for the year. In previous years, WINDFALL generally recovered 100 percent, or more, of drill-indicated reserves; unfortunately, in 1989 the company recovered only 55 percent of the gold reserves indicated in drill logs. Because WINDFALL was unable to secure additional placer ground in the Nome area, the company "broke their picks" and liquidated completely. The operation employed 35 people, and has pioneered revegetation and reclamation efforts in the Nome area. ANVIL MINING COMPANY, another large open cut placer mine, also operated in the Nome district about 2 km west of the WINDFALL open pit.

Several small operations also operated in the Nome district. ENGSTROM DREDGING COMPANY (Ron Engstrom) operated a 1-1/2-ft^3 bucketline stacker dredge on Basin Creek and finished up several old cuts worked in the 1940's. In 1990 ENGSTROM plans to float the dredge downstream for 1 km to virgin ground, which will require a large stripping effort. As a result, 1990 production will be severely reduced because of the necessary preproduction activities.

A relatively new large scale operator on the Seward Peninsula is GHD RESOURCES, who leases

ground from the partnership of RHEINHART BERG and THOR WETLESEN, long-time Seward Peninsula gold miners. GHD has successfully developed and produced gold from several deposits in the eastern interior and has become one of Alaska's most successful and innovative small gold mining firms. At their Kiwalik Flats operation in the Candle district, GHD processed 98,000-yd^3 (74,930-m^3) of pay gravels.

Smaller placer operators that mined gravels on the Seward Peninsula include: BUD MEYERS, RHEINHART BERG, and AU MINING CO. on Mud Creek (Candle district); ELMER MARTINSON, KORRY BLAKE, DAN MULLIKAN, MARK GUMAER, KOUGAROK MINING, and N.B. TWEET & SONS in the Kougorok district; and D.B. VIAL on Bull Run Bench (Fairhaven district); CLIFF PARENT on Bear Creek (Fairhaven district); ROGER NORDLUM on Candle Creek (Fairhaven district); and BILL MATHISEN on Iron Creek (Council district).

Operations in the Koyuk district on the southeastern edge of Seward Peninsula include: ED HATCH and TOMMY JOHNSON on Sweepstake Creek; DAVE GERKE on Tubitluk Creek; and PAT BLISS on Ungalik River.

Operations in the Ruby-Poorman and Innoko-Tolstoi areas south of Yukon River continued at levels established over the last several years. The most successful operations regionally include: GREEN MINING & EXPLORATION (Doug Green) on the Windy Bench; HOWARD MISCOVICH on Timber Creek; KEITH TRYCK on Ophir Creek (all in the Ruby-Poorman district); and ROSANDER MINING on Colorado Creek in the Tolstoi district. One new operator came on-line in the Ruby area, while another operation changed hands in the Tolstoi district. SPHINX AMERICA, a large company active in the Fairbanks district, initiated a new operation on Midnight Creek in the Ruby district, and recovered a small amount of tin during the production of gold. ALAMIN MINING, which had been operating on Bear Creek in the Tolstoi area for approximately eight seasons, discontinued activities in midsummer; the mine was taken over by SHELL MINING for the remainder of the season. Ownership of the property reverted back to ALAMIN in December. ROBERT MAGNUSON operated the Degnan claim group on Madison Creek near Tolstoi.

Rounding out the smaller operators in the Yukon drainage are MIKE HARTMAN, RUBY MINING CO. and JIM HAGGLAND (Ruby-Poorman); and CONRAD HOUSE (Kaiyuh Hills).

LOST RIVER MINING COMPANY, the largest and essentially only producer of tin in the United States for the last 15 years, exhausted its reserves on Cape Creek in the western Seward Peninsula, and dismantled its operation. During 1989 the mine produced minerals equivalent to 180,000 pounds (81,648 kg) of metallic tin, and sold the cassiterite concentrates to European-based industrial users. The mine employed nine people during the 125 day operating season. Since 1979, the mine has produced 2,072,000 pounds (939,859 kg) of tin from bench and modern stream placers downstream from a tin skarn system. Unfortunately, this long-time Alaskan tin producer was unable to find additional reserves at Cape Creek, and was not able to secure leases on other tin placer ground in Alaska. Consequently, no 1990 mine efforts are planned by LOST RIVER.

EASTERN INTERIOR

The level of gold mining activity in the eastern interior was on the upswing in 1989, despite problems with flooding, lower gold prices, and new recycling requirements. Estimates derived from DGGS questionnaire returns, and EPA and DEC documents indicate that 115 placer mines recovered 79,300 ounces (2,466 kg) of gold in 1989 compared to 89 operations and 76,550 ounces (2,381 kg) of gold production in 1988. This is an increase of 29 percent in mine operations and 4 percent in gold production. Judging from the 10 percent drop in the price of gold, overall economic viability probably declined. Mine employment climbed from 415 people in 1988 to 494 people in 1989, an increase of 19 percent.

The largest increase in the number of mining operations took place in the Circle mining district, which has the largest concentration of placer mines in Alaska. This historic placer district was affected by a 1987 court injunction that prevented or limited placer operations on federal mining claims in the Birch Creek drainage until cumulative environmental impacts were reviewed by the BLM, the leading land management agency for the area. The injunction was lifted in early 1989, and many small operations resumed mining activities under more strictly enforced 43 CFR 3809 Surface Management Regulations administered by BLM.

In the Circle district 36 mechanized sluicing plants and six development projects were active in 1989, compared to 24 active mines and 11 development projects in 1988. The roster of the largest and most successful mines in the district was similar to previous years: GHD RESOURCES on Eagle Creek; PAUL AND COMPANY on Crooked and Porcupine Creeks; ALASKA VENTURES (Vince Halverson) on Mammoth Creek; and HELEN WARNER MINING on Porcupine Creek. Other Circle district operators reporting in the DGGS questionnaire include: KELLY MINING; DISCOVERY MINING; GOLD POST MINING; AL VEAZY; MIKE DUGGER; DAN BROTHERTON; TOM CORNWALL; BOB MARCY; LYLE COLLEDGE; GEORGE SEUFFERT; FRANK

WARREN; STAN GELVIN; DEBBIE DALE; RON WREDE; MAGIC CIRCLE MINING; RON BLOOM; STEVE OLSON; RICHARD McCALUM; STEVE MASTERMAN; and JOHN COLE. The Circle district was hard-hit by a flash flood in late June and early July that put many operators out of commission for part of the summer. POINTS NORTH (Bob Cacy) experienced severe flooding and much of the heavy equipment and washing plant were buried under tons of gravel and silt. Some small hand miners benefited from leasing small fractions from larger operators. DON KNUTSON mined jewelry gold from lessor GHD RESOURCES on Eagle Creek (fig. 27). The 36 active mines produced an estimated 18,000 ounces (559 kg) worth $6.9 million in 1987; about 184 people were employed in area mines.

Activity in the Livengood-Tolovana district remained at about the same level as the last several years but some paystreaks were exhausted. DICK GERAGHTY ran out of ground on lower Olive Creek, and spent much of the season searching for new reserves. ALASKA PLACER DEVELOPMENT was again active on the Livengood Bench. CARL HEFLINGER stripped on Livengood Creek for 1990 production, and ROBERT TUCKER sluiced briefly on Lilian Creek near the town of Livengood. MAMMOTH MINES (Stan Rybachek) resumed underground mine operations at Wilbur Creek late in 1989, and stockpiled pay for summer (1990) sluicing.

As in the Circle district, more miners resumed operations in the historic Fortymile district (including Eagle) after the resolution of the Sierra Club vs. Penfold lawsuit. At least 13 mines produced in 1989, compared to nine in 1988. Operators in 1989 include: HAROLD NEVERS on American Creek; CHARLES HAMMOND on 45 Pup; GLEN COUCH on Atwater Creek; CRYSTAL BURNS on Wilson Creek; DAVE LIKINS on Fortymile River; ALICE BAYLESS, BILL MASSINGALE, AND ROBERT ROBERTS on Chicken Creek; BOB McGRANE on Arkansas Creek; JOHN BURNS on Davis Creek; MIKE BUSBY on Willow Creek; ROBERT WOLF on Walker Fork; and BILL ALDRIDGE on Poker Creek. Fortymile miners operated a mixture of small mechanized sluicing plants and large scaled up suction dredges. DAVE LIKINS spent much of the 1989 season designing a floating washing plant informally known as a "New Zealand floater," a design that is popular in Yukon Territory and New Zealand. These plants move ahead in their own pond while simultaneously reclaiming land, and are the preferred technology in sensitive environments along active river banks such as the Fortymile River.

The Eureka-Tofty and Rampart districts northwest of Fairbanks experienced flooding-related problems like other districts, but activity levels were also up from the previous year.

SHOREHAM RESOURCES LTD. spotlighted activity on Cache Creek in the Tofty area with the opening of a large scale placer operation that recovers gold with a byproduct of tin (cassiterite) and cesium minerals. The company stripped 192,000-yd^3 (146,803-m^3) and sluiced 26,000-yd^3 (19,880-m^3) recovering 2,190 ounces of raw gold and about 14,000 pounds (6,350 kg) of byproduct tin. They also stockpiled a concentrate rich in cesium. During the season, recoverable reserves were increased from 63,000 ounces (1,959 kg) of gold to 74,500 ounces (2,317 kg). The company hydraulically removed overburden, transporting the material to a containment zone using a completely enclosed system that recycled 100 percent of the mine process water and recycled all infiltrated water. SHOREHAM employs four full-time and 14 part-time miners to run the operation.

Small scale miners worked district wide. JOHN SHILLING worked Thanksgiving and Slate Creeks in the Rampart area; ED SALTER worked

Figure 27. *Recreational miners Mary McKinstry and Don Knutson display their 1989 Circle district catch. Photograph by Don Knutson, 1989.*

Alameda Creek; BILL CARLO and STEVE LOSONSKY worked Hunter Creek; and MARK KRENZKE mined Eureka Creek. JAMES CUDE also mined on Eureka Creek, but pulled out late in the season because of financial difficulties.

The Fairbanks mining district, which includes the upper Chatanika and Chena River drainages, as well as streams in the immediate Fairbanks area, made another strong showing in terms of gold production and number of active mines. From 26 placer and two lode mines, an estimated 35,500 ounces (1,104 kg) of gold and 8,600 ounces (267 kg) of byproduct silver worth $13.6 million was produced, and about 185 jobs were created (136 at placer mines and 49 at lode mines). Of these, about 75 jobs were of 8 months duration or more, while 110 jobs were more seasonal (less than 8 months) in nature. As a result of the February closure of the Grant gold mine on Ester Dome, which employed 30, the employment and overall gold production dropped about 10 percent.

POLAR MINING INC. on Goldstream Creek, and SPHINX AMERICA on lower Fairbanks Creek, were among the largest placer operators in the eastern interior region; the two companies collectively processed about 950,000-yd^3 (726,370-m^3) through trommel-equipped sluicing plants. Both POLAR and SPHINX have employed blasting and stripping techniques to remove overburden during winter months, and both provided year-round mine employment in the Fairbanks area. POLAR MINING improved efficiency by replacing motorized scrapers with Cat 773 off-highway trucks to haul overburden and pay. However, SPHINX dismantled it's Fairbanks Creek operation in September, citing adverse economic conditions caused by the decrease in the price of gold. POLAR MINING continues to operate; they have modified blasting techniques, reduced work hours, and reduced noise levels in response to complaints from area residents who live near the mine. POLAR MINING mines on federally patented claims owned by the ALASKA GOLD COMPANY, whose forerunner, the USSR&M COMPANY, operated eight bucketline stacker dredges in the Fairbanks district from 1928 to 1964. Other placer mines operating on ALASKA GOLD ground include: A.F. HOPEN on Dome Creek; WALTER ROMAN on Pearl Creek; RON ROMAN on Fish Creek; and THURMAN OIL & MINING on Fish Creek.

Other smaller scale mines active in the Fairbanks district include: COOK'S MINING (Fairbanks Creek); FRED CORNELIUS (Fox Creek); DAVE EBERHARDT and JOHN KOROBKO (Smallwood Creek) (fig. 28); WILLIAM RUSSELL (Gilmore Creek); HOWARD LAMBERT (Ester Creek); JIM CONWAY (Bullfrog Creek); DOUG CLARK (Upper Chena River); DON STEIN (Pedro Creek); ANDY MISCOVICH (Chatham Creek); JACK NEUBAUER (Fox Creek); VINCE MONZULLA (Yellow Pup); CACY PATTON (Gilmore Creek); SAM KOPPENBERG (Faith Creek); and McINTOSH MINING (Deep Creek).

DON REED mined placer gold from a small underground drift on Vault Creek. Nearby MIKE ROBERTS and FRANK ROBERTS began a moderate scale underground drift mine on Dome Creek, below the lower limit of former USSR&M dredging activities (figs. 29 and 30). During winter and early spring 1989, about 14,000-yd^3 (10,704-m^3) were brought to the surface, using a low-profile loader and a low-profile diesel haul truck, and stockpiled for summer sluicing. Gravels sluiced during the summer of 1989 averaged 0.04 oz/yd^3 (1.62 g/m^3); pay mined in late 1989 and early 1990 is expected to improve in grade. Drilling is performed with a jack-leg and blasting is done with ANFO, using gelatin primers that are initiated by safety fuse; each round releases about 25-yd^3 (19-m^3) of pay gravel and overburden. Although other drift developments have occurred in the Fairbanks district on Treasure, Lower Dome, and Cleary Creeks, and the Bigelow Bench, the ROBERT'S Dome Creek mine is the first

Figure 28. *John Korobko mining a small paystreak on intrusive bedrock at the head of Smallwood Creek, Fairbanks district. Photograph by T.K. Bundtzen, 1989.*

Figure 29. *Portal of the Dome Creek drift mine, showing low-profile dump truck. Photograph by Dennis Higgins, 1989.*

economically successful operation and has set the standard for other underground operations in the district.

Lode gold production in the Fairbanks district was confined to two mines on Ester Dome immediately west of Fairbanks. CITIGOLD ALASKA INC., a subsidiary of LA TEKO RESOURCES LTD. mined and stacked approximately 155,000 tons (140,616 tonnes) on two heap leach pads, and recovered 13,100 ounces (407 kg) of gold-silver dorė, the final mine product. The dorė contained 7,400 ounces (230 kg) of gold and 5,700 ounces (177 kg) of silver worth $2.7 million. Four full time and 30 seasonal employees operate Alaska's only cyanide heap leach gold mining operation.

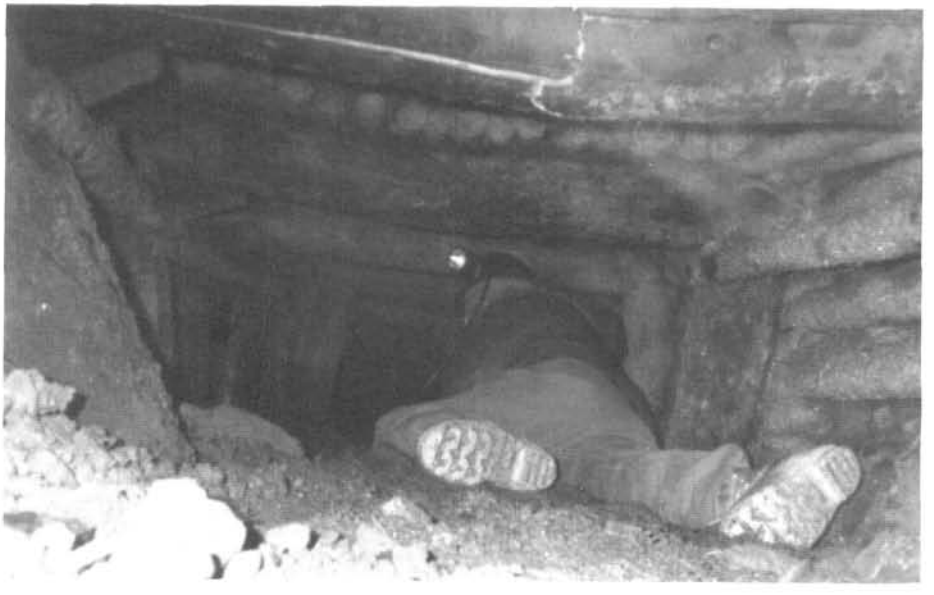


Figure 30. *A 1910-era ice-filled drift, encountered in the Dome Creek drift mine. Photograph by Dennis Higgins, 1989.*

CITIGOLD encountered several technical and environmental problems during the season. Late in 1988, leaks were found in the primary liners of the 1987-88 pads, and CITIGOLD was required by ADEC to neutralize the heaps in preparation for remedial work. CITIGOLD elected not to repair the 1987 and 1988 pads, but decided to instead construct a new 1989 pad with the capacity of 155,000 tons (140,616 tonnes). Because controversy was raised by some local residents over the operation, a public hearing was held by ADEC on May 31, 1989. BLM also held a public meeting about the mine because some of the operation was on unpatented federal mining claims; BLM completed an Environmental Assessment (EA) on the project and issued a Record of Decision on August 8, 1989, that approved a five-year plan of operation. ADEC obtained an Alaska Department of Law review of a Compliance Order dealing with the liner problem and reclamation of the 1986 heap leach pad (Peterson, 1990). This Compliance Order is expected to be signed in 1990. According to company officials, the extensive regulatory oversight contributed to: (1) a shorter operating season; (2) several significant changes to the plan of operation over the year; and (3) lower gold-silver production. CITIGOLD plans on a smaller heap leach effort in 1990, and instead will concentrate on exploration of the ore zone. Inferred reserves amount to about 1,100,000 tons (997,920 tonnes) grading 0.1 oz/ton (3.4 g/tonne) gold and .075 oz/ton (2.5 g/tonne) silver; reserve calculations are based on extraction to a depth of 230 ft (70 m).

TRI-CON MINING LTD., operator for SILVERADO MINES U.S. INC., ceased operation of the Grant mine and mill complex in mid-February 1989 (fig. 31). During the seven weeks of mine production in 1989, the mill processed 8,000 tons

(7,257 tonnes) which yielded 732 ounces (23 kg) gold and 138 ounces (4.3 kg) silver, worth $200,000. The 235-tpd-rated mill began production in December 1987, and until the operation was suspended in February 1989, produced 9,454 ounces (294 kg) of gold, and 3,658 ounces (114 kg) of silver, from 96,555 tons (87,594 tonnes) of ore, at an average recovered grade of .098 oz/ton (3.3 g/tonne) gold and .038 oz/ton (1.3 g/tonne) silver.

The Grant mine essentially operated on "break-even" economics and employed 29 mill and mine personnel and eight to 12 subcontracted truckers during the 15 month production period. After the 100,000-ton-rated (90,720 tonne) tailings pond filled up in early 1989, the company decided that the costs for construction and permitting of a new tailings facility was prohibitive, and mining was temporarily suspended. After the closure, ADEC issued a Notice of Violation to TRI-CON for failing to report the discharge of a hazardous substance. A single water sample indicated that cyanide had escaped the compacted silt tailings liner in December 1988; TRI-CON reported the incident in March 1989. TRI-CON has installed an extensive water monitoring system that includes three wells for testing groundwater. They also dewatered the tailings pond. Cyanide levels are below drinking water standards and no cyanide has been detected in the monitor wells (Peterson, 1990).

Late in 1989, SILVERADO signed an option agreement with AMERICAN COPPER & NICKEL, the American subsidiary of the Canadian firm INCO, to explore and develop SILVERADO mining properties on Ester Dome, including the Grant complex.

Mining activity in the Richardson district (Tenderfoot) 70 miles (112 km) southeast of Fairbanks was highlighted by operation of TRI-VALLEY MINING COMPANY's Democrat gold-silver mine at the head of Democrat Creek. The ore zone consists of quartz, feldspar, free gold and complex antimony-lead-silver sulfosalt veinlets in quartz-orthoclase "Alaskite" porphyry. The geology of the district is briefly summarized by Bundtzen and Reger (1978). Vertical, north-trending minable zones range up to 300-ft (91 m)-wide with unexplored lateral and vertical extensions. Drill confirmation of reserves has been difficult because of the large size of gold particles. TRI-VALLEY subcontracted a Montana firm, EMPIRE SAND & GRAVEL, to excavate the ore body and construct a plant to process the ores. The plant consists of a placer type 10-ft-diameter (3-m) revolving trommel and a sluice box-jig recovery (fig. 32). The ore was crushed to 4 inches and fed through the plant. The plant recovered about 2,200 ounces (68 kg) of raw gold from 75,000 tons (68,040 tonnes) of ore. Ore minerals submitted by TRI-VALLEY to State Geologist Robert Forbes of DGGS for analysis contained numerous sulfosalts of silver and antimony including: acanthite, andorite, stephanite, pyrargyrite, and owyheeite. Late in the season, TRI-VALLEY successfully poured gold-silver bullion bars from sulfide-sulfosalt concentrates collected in the recovery process (see back cover). Plans for 1990 include expansion of the mine pit, and installation of a more sophisticated crushing and recovery system to enhance gold recovery.

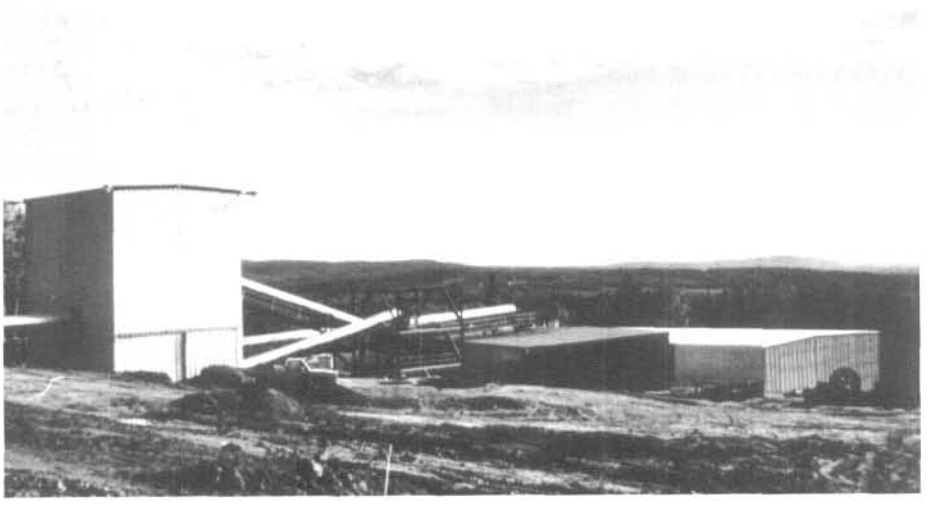


Figure 31. *Silverado Mines U.S., Inc. mill complex, Grant mine, Ester Dome, eastern interior Alaska. Photograph by C.B. Green, 1989.*

Activity levels in the Bonnifield district along the north flank of the Alaska Range were similar to levels of the last three years, with eight placer operations reporting production activities. Those actively mining include: FOUR BROTHERS MINING, and LES ZERBE (Totatlanika River); JACK LACROSS, and JACK ZUPAN (California Creek); JIM ROLAND, and TOMMY FAA (Moose Creek); BARNEY HARROD (Bonnifield Creek); RICHARD KNUTSON (Delta River); BOB SOUTHWOOD (Gold King Creek and St. George Creek); P.J. CANON (Grubstake area); and RALPH SIMONSON (Eva Creek).

For the fourth operating season, all was quiet in the Kantishna mining district, a former producer of gold, silver, antimony, and minor lead and zinc. A court order in 1985 (Sierra Club vs. National Park Service) enjoined the NPS from issuing plans of operations to active mines until individual and cumulative environmental impacts were addressed. In the spring of 1989, a Draft Environmental Impact Statement summarized the cumulative impacts mining had on NPS managed

lands. A proposed-action alternative world allow mining under strict supervision, and limit certain private property uses, but offers a "buyout" plan for affected properties.

In June 1989, a former NPS claim examiner, TERRY CHRISTIANSON, who was performing a mineral examination on valid claims in the Caribou Creek drainage of the Kantishna district, was charged with mining without an approved plan of operation under 36 CFR 5.14 (Mining on Park Lands). CHRISTIANSON claims he was operating an 8-inch suction dredge on valid federal claims in order to locate the discovery point and evaluate claims held by owners DAVID BEYERS and ARLEY TAYLOR. The public defenders office representing CHRISTIANSON maintains that Caribou Creek is a navigable river, and that the NPS has no jurisdiction in the state-controlled waters. A court decision is expected later in 1990.

SOUTHCENTRAL REGION

In 1989, metal production in the southcentral region was dominated by the Denali mine, operated by the VALDEZ CREEK MINING COMPANY (VCMC), approximately 55 miles (88 km) east of Cantwell in the Denali Highway corridor. This single operation accounted for over 83 percent of the estimated 73,100 ounces (2,273 kg) of gold produced from this region in 1989.

From January through October 1989, VCMC placer operations produced 71,992 ounces of raw placer gold that yielded 61,403 ounces (1,909 kg) of refined gold, and 10,400 ounces (323 kg) of refined silver from 453,473-yd^3 (346,725-m^3) of pay gravels. The total quantity of stripped overburden amounted to 6,408,120-yd^3 (4,899,648-m^3), for an overall stripping ratio of 14:1. Average tenor of the processed pay gravel was 0.135 oz/yd^3 (5.49 g/m^3) gold.

The Valdez Creek project is operated by VALDEZ CREEK MINING COMPANY (VCMC) and owned by three Canadian mining companies: CAMINDEX MINES, LTD. (MVB CAPITAL), now VALDEZ MINES, INC.; CAMBIOR MINES; and AMERICAN BARRICK RESOURCES CORPORATION. The property was obtained from DOUG CLARK and CURT AMES in 1983. They had worked the property earlier on a small scale.

Since operations began in 1984, VCMC has been Alaska's largest gold mine for five of the last six years and has produced 202,421 ounces (6,296 kg) of refined gold. Geological reserves at the project now total 627,000 ounces (19,502 kg), including 316,000 ounces (9,828 kg) in the proven and probable category. The Valdez Creek project has exploited two newly discovered paleochannels adjacent to a previously mined paystreak known as the Tammany Channel (fig. 33). All three of these, and other paystreaks are ancestral drainage incisions of Valdez Creek that have responded to changes in glacially affected stream hydraulics since Sagamon time (Reger and Bundtzen, 1990). Winter operations have been carried out at the Denali mine since 1986, and are conducted until temperatures reach -40 °F (-40 °C), when heavy equipment begins to fail to operate properly. The Valdez Creek project has been faced with a series of challenges in implementing year-round operation and unit-costs of production have been excessively high from 1986 to 1988. Under new management in 1989, VCMC implemented a successful mine design improvement that cut water usage, reduced maintenance down time, and reduced overall fuel consumption. At the same time, more accurate ore reserve calculations were used and a new pit design ensured a more economic and safer open pit operation (Hughes, 1990). Additionally, land reclamation efforts were expanded and by mid-summer 1989, 135 additional acres (55 hm^2) of land had been contoured and reseeded (Martin, 1990) (fig. 34). Unit-costs of production dropped from $615/ounce in 1987 to $514/ounce in 1988 to $312/ounce in 1989.

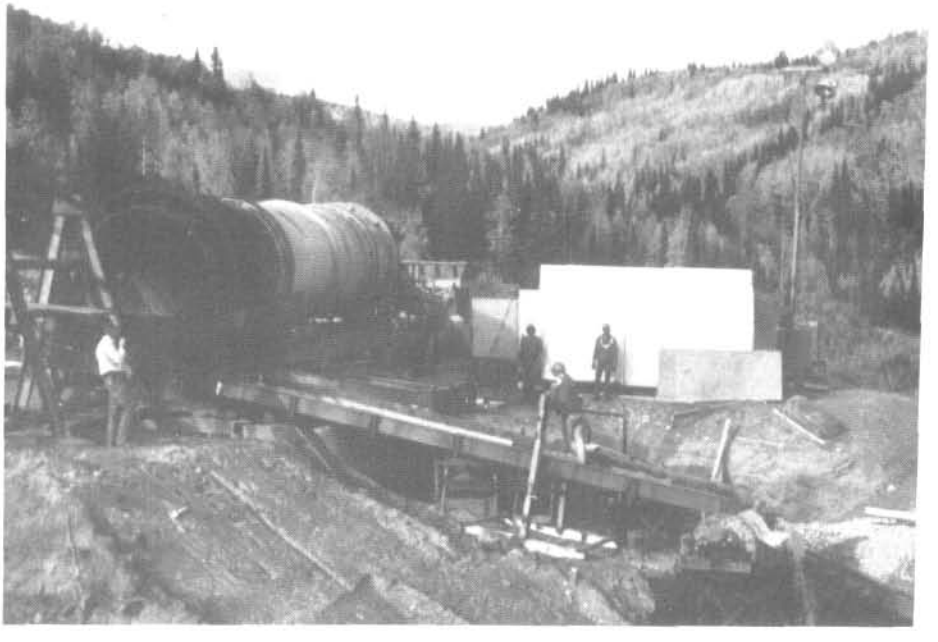


Figure 32. *Empire Sand & Gravel surface washing plant at Tri-Valley's Democrat mine, Richardson district. Photograph courtesy of Tri-Valley Mining Co., 1989.*

Despite profitable returns of approximately $2.4 million in 1989, Alaska's largest gold mine was closed October 17, 1989, and the 165 employees were laid off. The decision to close the mine was made by the owners in March 1989, as a result of declining gold prices and rising cost projections.

In late December 1989, representatives from MVP CAPITAL (51 percent owner), CAMBIOR (25.875 percent owner), and AMERICAN BARRICK RESOURCES (23.125 percent owner) re-examined the possibility of reopening the mine in 1990. The main item under consideration was the likelihood of the mine making a profit after spending $6 million to divert Valdez Creek upstream from pit A-6, as required by the Alaska Department of Fish and Game (ADF&G). VCMC has discussed other options with ADF&G officials including providing a local hatchery, or other fishery enhancement programs, as an alternative to the expensive stream diversion. MVP CAPITAL indicated that the mine could reopen in 1990 if gold prices rise above $400/ounce, and if some mitigation of the stream diversion program could be worked out.

Most other placer mines in the southcentral region were of significantly smaller scope than the VCMC operation. Long-time producer MRAK PLACER MINE continued to mine gold in the upper Willow Creek drainage of Hatcher Pass, north of Palmer. HOFFMAN MINING worked several cuts on Limestone Creek in the Chistochina district of the eastern Alaska Range. HOFFMAN had previously operated a successful placer mine on Dan Creek in the Wrangell Mountains, but was forced out by the 1985 National Park Service lawsuit which prevented approval of mine plans of operation. Other mines active in the Chistochina district were GEORGE LIVERMOORE (Miller Gulch); BEERMAN MINING (Big Four Creek); and ALASKA MINERAL RESOURCES (Chisna River). Near Paxson, ED VEGOREN and J. HALL prospected and worked Rainy Creek; and R. KNUDSON trenched Broxson Gulch, a tributary to Eureka Creek.

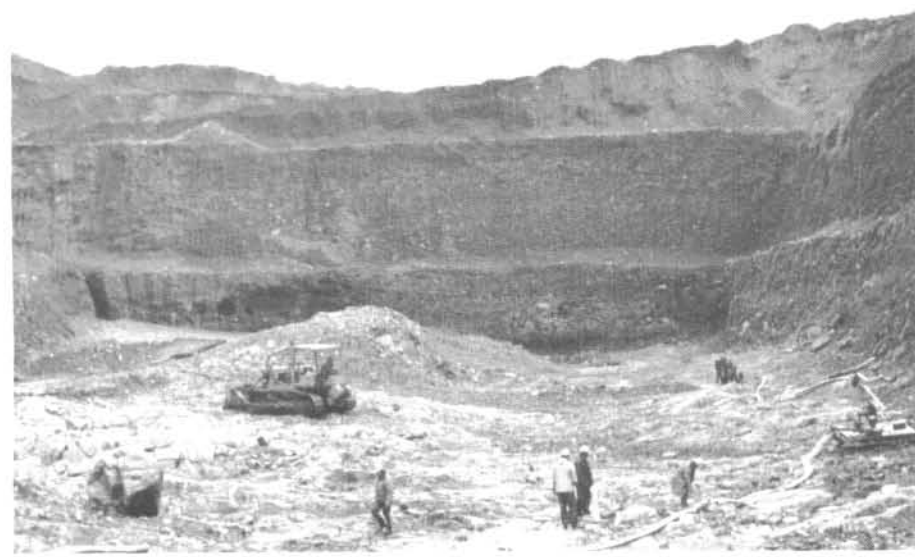


Figure 33. *Pit A-6 at the Denali mine, southcentral Alaska, showing gold recovery activities on resistant porphyry intrusive bedrock. Photograph by T.K. Bundtzen, 1989.*

Figure 34. *Reclaimed spoil piles, Denali mine, southcentral Alaska. Photograph courtesy of VCMC, 1989.*

Seven operations were active in the Yentna district. The MUELLER-SNEED partnership and RANDY BROWN worked Peters Creek; and the R. YOUNG-J. WADKINS partnership mined a cut on Falls

Creek. TOD BAUER operated on Gold Creek in the Talkeetna Mountains. HOWARD McWILLIAMS rebuilt a washing plant to be operated on John's Creek, a tributary to the Chunilna River. MARTIN HERZOG continued to reclaim tailings on Cache Creek. BOB CARLSON operated on upper Cache Creek. EMPIRE EXPLORATION tested tailings on Willow Creek. WERNER SCHUSTER dredged on upper Bird Creek.

Suction dredges were again active in the Hope mining district on the Kenai Peninsula. Miners reporting production activities in 1989 include: the GAEDE-LINDMAN partnership at Heaven's Gate (Canyon Creek); FRONTIER SERVICES (Roger Moore) on Resurrection Creek; and ZIMMER MINING on Quartz Creek; JOE KRALL on Canyon Creek; F. COUCH on Stetson Creek; J. BUGLI on Cooper Creek; PORTER on Crescent Creek; SCHAEL on Mills Creek; and WILLIAM SMITH on Silvertip Creek. These enthusiastic miners spent from nine to 100 days operating relatively small suction dredges (noted for their low overhead costs) along bedrock paystreaks in modern, high energy streams that typify the Kenai Peninsula.

Other small placer mines were scattered throughout the southcentral region. W. BLONDEAU worked placers on Mineral Creek near Valdez. R. DIEHL assessed bedrock placers on Tasnuna and Lowe Rivers near Cordova; C. HUTCHESON worked claims on Albert Creek in the Nelchina district; and R.L. CORBIN worked nearby Caribou Creek. HOPE MINING COMPANY operated on Resurrection Creek in the Hope district (fig. 35).

Two lode properties produced gold-silver bullion in the southcentral region. ALASKA HARDROCK MINING COMPANY and joint venture partner THOR GOLD, INC. mined 3,600 tons (3,265 tonnes) of ore averaging 0.75 oz/ton (25 g/tonne) gold with byproduct silver from the Independence mine in the historic Hatcher Pass district north of Palmer, Alaska. Seven men worked four months using underground room-and-pillar, slusher stoping mining methods to extract the high-grade ores. The old Independence mine was operated mainly prior to 1950, and was one of Alaska's largest lode gold mines during its peak productive years. It was briefly reopened in 1981-82 by ENSEARCH CORPORATION, but that mining enterprise failed, ostensibly because of difficulty defining sufficient tonnages of minable ore. In 1990, ALASKA HARDROCK MINING plans to build a 50-ton-per-day (45 tonne) mill facility, and develop several individual ore bodies that contain 6,000 tons (5,443 tonnes) of quartz-gold ore of undetermined grade. Specifically, mine production plans are for driving 900 ft (275 m) of 3-m-high drift on the Hope block, and 150 ft (46 m) of development drift on the Independence vein north of the 1,700-ft-level.

ALASKA FRONTIER SERVICES, who also produce modest amounts of placer gold on the Kenai Peninsula, produced 20.2 ounces (628 g) of gold from 10 tons (9 tonnes) of ore at the old Palmer lode mine in the Hope mining district. The high-grade ore was recovered from unmined stopes and isolated pillars in the mine workings.

SOUTHWESTERN REGION

Metal production in the southwestern region was derived from well established mining camps including: the Innoko; Iditarod; Aniak; and Iliamna mining districts. Total 1989 regional production was 13,950 ounces (434 kg), a decrease of 6 percent from the 1988 total of 14,800 ounces (460 kg). The 26 mine operators who worked here provided 102 seasonal jobs in one of the most sparsely populated regions of Alaska. Judging from the questionnaire comments of six mining companies, excessive rainfall (flooding) and implementation of water recycle technology were the main reasons for the decrease in activity.

Long-time Innoko miner DR. PAUL SAYER continued to mine gold on Little Creek, a tributary to the Innoko River. JOHN O'CARROLL was busy sluicing on Spruce Creek, and worked on a cut at the nearby Dodge Creek placer. S. STOVER and A. ANDERSON worked on Yankee Creek; and the MAGNUSON MINE (Lloyd and Warren) worked placers on Ganes Creek, the district's largest producer of placer gold and known for

Figure 35. *Hope Mining Company operation on Resurrection Creek, Hope district. Photograph by Mitchell Henning, 1989.*

coarse nuggets. NORCROSS and PLANO continued to work actively on their Anvil Creek property.

The Flat camp in the Iditarod district was worked at levels comparable to other years in the 1980's. MISCO-WALSH MINING COMPANY processed 50,000-yds^3 (38,230-m^3) of pay from a composite residual-stream placer system on upper Otter Creek, near its confluence with Black Creek. The concentrates contained recoverable quantities of silver and tungsten in addition to gold. PRINCE CREEK MINING COMPANY (Alvin Aghoff) again worked upper Prince Creek but experienced extreme difficulty in installing a total recycle system as is presently required by USEPA. After finally developing a pay zone suitable for recycling, heavy rains hindered operations, and AGHOFF managed only nine hours of sluicing. RICH and JOHN FULLERTON worked claims on Willow and Flat Creeks, and RICHARD WILMARTH trenched lower Chicken Creek.

The George River drainage east of the main Iditarod-Flat camp maintained three small placer mines. GLENN BASS worked a small bench deposit on Michigan Creek, and nearby JULIAN CREEK MINING COMPANY had another successful year on Julian Creek, a tributary to the George River. L.E. WYRICK mined a small amount of gold from Granite Creek, the uppermost tributary to the George River, but actually spent most of his season on contract to BATTLE MOUNTAIN EXPLORATION who are exploring nearby lode claims.

LYMAN RESOURCES OF ALASKA worked a small cut on Quartz Gulch, a tributary to Donlin Creek in the Aniak district. Like WYRICK on Granite Creek, LYMAN spent much of the summer assisting WESTGOLD's exploration of nearby hard-rock antimony-gold prospects associated with quartz porphyry bodies.

DAVE PENZ worked pay on Buster Creek, a tributary to Kako Creek in the Marshall district of the lower Yukon River, but reported that heavy rains caused a "near total blowout" of stripping operations. As a result, production was just a fraction of what was achieved in previous years.

RICHARD BUSK worked a small pay cut on Synneva Creek, a tributary to Bonanza Creek in the Mulchatna-Nushagak Rivers drainage. These claims were worked for 30 years on a small scale by TERRY and VICTORIA GILL, who sold the claims to BUSK several years ago.

At least two operations processed pay in the Nyac district. MARVEL DOME MINING CO. (Mark Matter) sluiced on Eureka Creek and TULUKSAK DREDGING COMPANY continued a large non-float processing plant on Bear Creek, a tributary to the Tuluksak River. TULUKSAK has recently operated a 4 ft^3-rated bucketline stacker dredge in the Nyac district and own other dredges nearby.

SOUTHEASTERN REGION

The southeastern Panhandle--dormant for many years in terms of metallic mineral production--came alive with the opening of the Greens Creek mine (see front cover) on Admiralty Island, 18 miles (29 km) southeast of the capital city, Juneau. During the year they processed 264,600 tons (240,045 tonnes) of ore, and extracted 5,166,591 ounces (160,702 kg) of silver, and 23,530 ounces (732 kg) of gold. The concentrates from this polymetallic deposit also yielded 9,585 tons (8,698 tonnes) of lead and 19,843 tons (18,007 tonnes) of zinc. It became the largest silver producing mine in the United States in its first year of operation. The significantly higher metallic production reported by Bundtzen and Swainbank (1990) for the Greens Creek mine were derived from data supplied by the company on mill head grades prior to milling. Ownership of the mine also changed hands in 1989 when RTZ acquired a 53 percent majority interest in Greens Creek through its purchase of BP MINERALS (a move that made RTZ the world's largest mining company). KENNECOTT CORPORATION became RTZ's metal mining subsidiary in the U.S. and the operator of Greens Creek. The other joint venture partners are HECLA MINING (28 percent), CSX OIL AND GAS CORPORATION (12.6 percent), and EXALAS RESOURCES (6.3 percent). EXALAS is the only original partner remaining from when the property was first explored back in 1973.

The mine was designed to process 1,000 tons (907 tonnes) of ore per day, but by year-end the production level exceeded that and neared 1,100 tons-per-day (998 tonnes). The company plans a 70,000 ft (21,340 m) drilling program to further delineate the reserves before a decision is made on plant expansion.

The primary ore extraction method is drift-and-fill, with cut-and-fill techniques used in steeply dipping areas. Although the mine life is estimated to exceed ten years, the prospects for proving up more reserves are considered excellent.

The Greens Creek orebody is a bedded base and precious metals sulfide deposit that lies in a distinctive transition zone between light-colored quartz-sericite phyllite units in the hanging wall and a thick section of black carbonaceous argillite, carbonate, and chert in the footwall. Mapping and drilling indicate that the horizon hosting the sulfide mineralization lies within the overturned limb of a large fold. The project began in 1973 with the initial geological exploration conducted by the Pan Sound joint venture group consisting of NORANDA EXPLORATION COMPANY, MARIETTA RESOURCES INTERNATIONAL, TEXAS GULF RESOURCES (now CSX), and EXALAS RESOURCES CORPORATION. The discovery drillhole was drilled in 1975, and by 1978, a 9-ft by 12-ft (2.75-m by 3.65-m) exploration adit had

been driven. The gathering of environmental background data was also started in 1978, and in 1981 preliminary engineering began. By 1985, further exploration revealed a dramatic increase in metal grades and the extent of the mineralization. By the end of 1986, indicated minable reserves were estimated to total 3.5 million tons (3.17 million tonnes) at 24 oz/ton (822 g/tonne) silver, 0.18 oz/ton (6 g/tonne) gold, 9.7 percent zinc, and 3.9 percent lead. By the end of 1989, probable ore reserves had been boosted to 4.7 million tons (4.26 million tonnes) of ore with the same grades.

A road from the Hawk Inlet dock site was begun in 1985, and pioneered through to the mine on upper Greens Creek in late 1986. In January 1987, a new portal was collared, and drifting began on the 920-adit which now serves as the main ore haulageway (fig. 36). A 5 mile (8 km) road was completed between the Hawk Inlet ship-loading dock and Young Bay on the northeast side of Admiralty Island, where a second dock was built for commuter boats that ferry mine workers from Juneau.

In 1988, the 1,000 (907 tonne) ton-per-day concentrating mill was constructed which processes minus-18-inch ore from the mine (figs. 37 and 38). The mill's grinding circuit uses a combination of a semi-autogenous grinding mill and a ball mill. The concentrates are trucked from the mill site to the Hawk Inlet dock for shipment to smelters in England, Belgium, Italy, France, Japan, and Korea (fig. 39). The mine generates its own power with three 2.2-megawatt generators.

The final price tag for mine development was $114 million, significantly above the $80 million originally estimated three years ago. Poor weather, safety investigations, break downs, and equipment adjustment were cited by company officials as reason for the escalated costs.

The Greens Creek project faced "teething" problems associated with new mine developments (fig. 40). On March 25, 14 miners were evacuated to Juneau for medical treatment after an explosion of undetermined origin caused smoke to fill one area of the mine after blasting. On May 19, a similar incident resulted in five miners being hospitalized for observation. The puzzling explosions were determined to result from the buildup of fine-grained sulfide dust after blasting in massive sulfide ore. The unusual problem has not been reported in a U.S. mine since 1941. Generally the problem occurs within seconds after explosive charges extending tunnels, drifts, or stopes are ignited. The secondary dust explosions were hot enough to melt ventilation tubes in the mine. After the second blast, Greens Creek officials closed the high-grade ore zones for six weeks until the cause-effect relationship was determined. Use of a sprinkler system to saturate walls and air during blasting operations apparently solved the problem; no further incidents of this nature have been reported.

GREENS CREEK uses about 50 percent of the tailings as backfill underground. The mill process creates dry tailings, reducing the tailings area to roughly 35 acres (14 hm^2), which is less than one-third of what a wet tailings area for a mine of this size would cover.

A 100-ft catamaran ferry, the M.V. ALASKAN DREAM, which has a capacity of 140- to 150-passengers was constructed by ALLEN MARINE WAYS of Sitka and delivered to the project in 1988. The catamaran transports mine workers on the 30-35 minute daily commute between Auke Bay near Juneau and Young Bay. A second smaller catamaran serves as a backup ferry.

In an effort to maximize local hire, GREENS CREEK and the UNIVER-

Figure 36. *Mine hauler with a load of lead-zinc-silver-gold ore, Greens Creek mine. Photograph courtesy of Greens Creek Mining Co., 1989.*

SITY of ALASKA SOUTHEAST organized training classes which were held starting in 1988. ECHO BAY MINING COMPANY also participated in the local training program in 1989.

A permanent workforce of about 235 people, and as many as 15 service contractors, are employed by GREENS CREEK MINING COMPANY, making it Juneau's largest private employer. Over 65 percent of GREENS CREEK's contracts have been awarded to local firms, and nearly 70 percent of the workforce is from the Juneau area. Direct income to the Juneau community in wages, salaries, and benefits is estimated to exceed $10 million annually.

Small placer mines were active in the southeastern region. PAUL GLANVILLE worked strandline deposits near Yakataga processing pay at a daily rate of 20-yd^3 (15-m^3). In addition to gold the sandy payzone also contains significant garnet and ilmenite concentrations.

BIG NUGGET MINING COMPANY, long-time Porcupine district operation near Haines, did not report production but rather focused on development in preparation for the 1990 season, when BIG NUGGET expects to process 120,000-yd^3 (91,752-m^3) of pay. J. FABRIZIO and JOE JURGELEIT operated small placer gold mines on Porcupine Creek near Haines. A major motion picture corporation, is filming several sequences of a rendition of Jack London's famous novel "White Fang" in the Porcupine mining district. Movie officials are attempting to negotiate for the use of various mining properties in the area for the film.

WILLIAM VEIKANYE mined small placer cuts on the Salmon River near Hyder. This is the first record of small scale placer gold activity there we have received in many years.

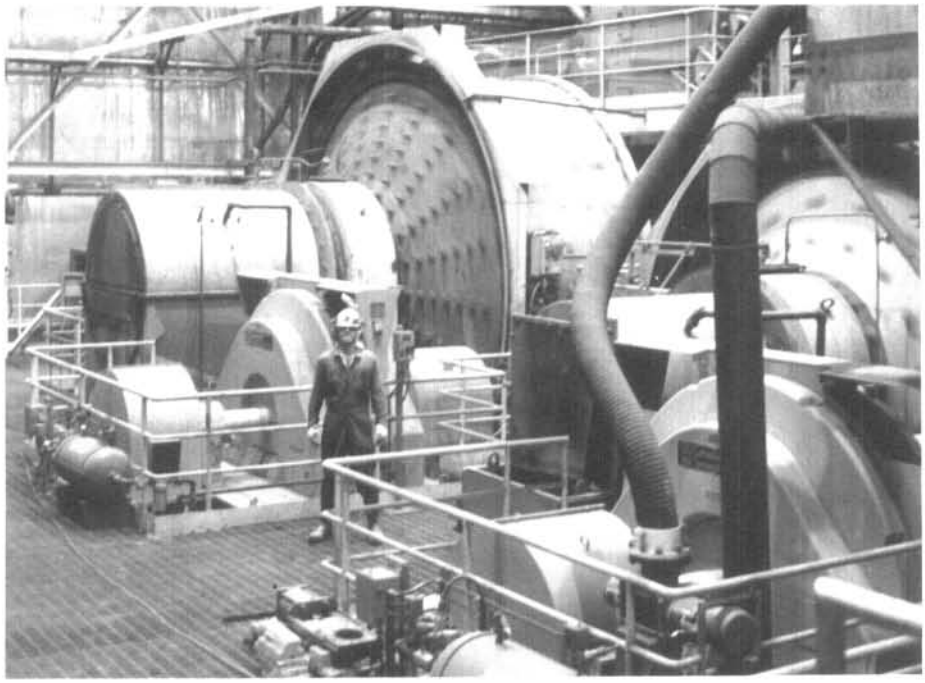


Figure 37. *The 1,000 ton-per-day ball mill and semi-autogenous grinding circuit, Greens Creek mine.*

Figure 38. *Flotation cell configuration in the Greens Creek mill. Photograph courtesy of Greens Creek Mining Co., 1989.*

INDUSTRIAL MINERALS

The value of industrial mineral production during 1989 was $61.4 million, compared to $73.4 million produced in 1988, a reduction of 16 percent. The volume and value of sand-and-gravel decreased approximately 18 percent and quarry stone production decreased 17 percent from the previous year. Sand-and-gravel use in Alaska's North Slope petroleum fields came to a virtual standstill, and use in most Alaskan urban areas has remained

Figure 39. *A 25,000-ton-capacity freighter loads concentrates from Greens Creek mine at the Hawk Inlet facility. Photograph courtesy of Greens Creek Mining Co., 1989.*

weak. Additionally, the completed Red Dog and Greens Creek mine construction projects, which previously used large amounts of riprap, sand-and-gravel, fill dirt, and shot rock, substantially decreased their use of these commodities. A further measure of the relative weakness of the sand-and-gravel industry is the loss of companies that extract these commodities. Of the 42 sand-and-gravel companies and agencies that returned 1989 DGGS mineral questionnaires, 10 or 1/4, indicated that they had gone out-of-business in the last 2 years (table 11). Some of these failed businesses had returned questionnaires reporting production activities since 1981. Most of the stone production used in Alaska in 1989 was utilized at the Bradley Lake hydroelectric project near Homer, and on several road projects in southeast Alaska.

Despite the current weakness of the industry, indications are that 1990 could be a better year. ALYESKA PIPELINE SERVICE COMPANY has announced that major repair work for the trans-Alaska pipeline will be initiated; riprap and sand-and-gravel will be required. The Alaska Department of Transportation and Public Facilities (DOTPF) highway reconstruction projects are expected to continue at least at levels established in 1989. Several new large construction projects are scheduled for both the Fairbanks and Anchorage areas. Finally, major mineral exploration projects in the southeastern Panhandle, and in southern Canada, are expected to require stone and aggregate, if affirmative mine development decisions are made (table 12).

NORTHERN REGION

Oil field development projects on the North Slope of Alaska, where approximately 25 percent of U.S. oil production occurs, have been significant users of sand-and-gravel and riprap for roads, pads, erosion controls, causeways, and other infrastructure development. Between 1974 and 1988, an estimated 183 million tons (166 million tonnes) of sand-and-gravel, or about 29 percent of total statewide production for that period, were used to build haul roads, drill pads, airports, camps, and specific oil field facilities. However, in the last three years (1987-89) aggregate use in the North Slope petroleum fields has averaged only about 3.5 percent of total statewide use.

In fact, the 188,167 tons (170,705 tonnes) used in 1989 was just 1.3 percent of the total 14.5 million tons (13.1 million tonnes) recorded for statewide sand-and-gravel applications.

ARCO ALASKA and BP EXPLORATION were responsible for all reported North Slope use. ARCO reported that Kuparuk mine site C supplied 73 separate small drill sites, ramps, airport trench lines, pads and pulling slope jobs. Kuparuk mine site E supplied gravel for two drill pads; and Kuparuk mine site F supplied 43 small drillsites, road slopes, access roads, and waste facility jobs. Gravel use in the Prudhoe Bay field was supplied by "Pit 23" and was used for pad expansions, containment dikes, docks, and ramp repairs.

In most cases, the various small jobs in the petroleum fields were mainly repair jobs, and not construction of new facilities. Both BP EXPLORATION, and ARCO also recycled gravel from older obsolete runways, pads, and roads in contrast to mining primary sources.

Approximately 1.5 million tons (1.36 million tonnes) of sand-and-gravel and 1.2 million tons (1.08 million tonnes) of shot rock and riprap were used to construct a tailings pond at the Red Dog mine project north of Kotzebue. Most of the material used was stripped off the massive sulfide ore body as it was being prepared for mining.

WESTERN REGION

Approximately 2.15 million tons (1.95 million tonnes) of sand-and-gravel were used in the western region, nearly double the volume used in 1988. Construction of WESTGOLD's sheet pile docking facility and DOTPF road construction on the Seward Peninsula was responsible for most of the

increase. Most of the backfill used in the WESTGOLD project was provided by MARTINSON GRAVEL & CRANE, INC. of Nome. The type of open-cell docks that have been designed by the Anchorage firm of PERATROVICH, NOTTINGHAM, & DRAGE INC. have been built in Juneau, Dutch Harbor, Seward, Valdez, Portage, and Nome; the open-cell design has installation costs half that of conventional docking facilities.

EASTERN INTERIOR REGION

Twelve sand-and-gravel firms reported production of 4.6 million tons (4.2 million tonnes) worth $9.15 million, compared to 5.5 million tons (5 million tonnes) and $12.26 million in 1988. About 350,000 tons (317,520 tonnes) of riprap and quarry stone worth $1.35 million were also produced from two quarries during the calendar year. Although the volume of production declined by one-fifth from the previous year, demand remained relatively strong compared to other regions of the state. The largest projects include construction of the "Geist road extension" through the Fairbanks railroad-industrial area, and road rebuilding efforts along the Alaska Highway. EARTHMOVERS INC. expanded their large Aurora and Hanson Road pits to supply the Geist road project (fig. 41). FAIRBANKS SAND & GRAVEL mined 236,051 tons (214,145 tonnes) of sand-and-gravel from state leases on the Tanana River floodplain, using a clam-shell floating on a dredge. The company employed 11 people to mine and crush the sand-and-gravel into various aggregate products. Additional workers haul the aggregate to various worksites in the Fairbanks area. DOTPF used 220,255 tons (199,815 tonnes) of undifferentiated gravel and riprap for public road maintenance in Fairbanks, Delta, Tok, Nenana, and Healy. This figure does not include cut-and-fill on the airport projects.

Sand-and-gravel was produced from University of Alaska lands in the Fairbanks area. H&H CONTRACTORS purchased 10,000 tons (9,070 tonnes) of UA gravel from the Spinach Creek and Harding Lake quarries; GREAT NORTHWEST INC. extracted 20,100 tons (18,234 tonnes) of gravel and fill from the College Road peat and gravel quarry; and EVECO INC. processed 23,609 tons (21,418 tonnes) of gravel from university lands on First Chance Creek, selling the gravel and recovering placer gold. YUTAN CONSTRUCTION COMPANY again operated their Brown's Hill rock quarry but reported activities at about 60 percent of the previous year. ALASKA GOLD COMPANY sold undisclosed amounts of washed coarse gravel tailings derived from past bucketline dredging activities to numerous small and larger scale sand-and-gravel firms throughout the Fairbanks area.

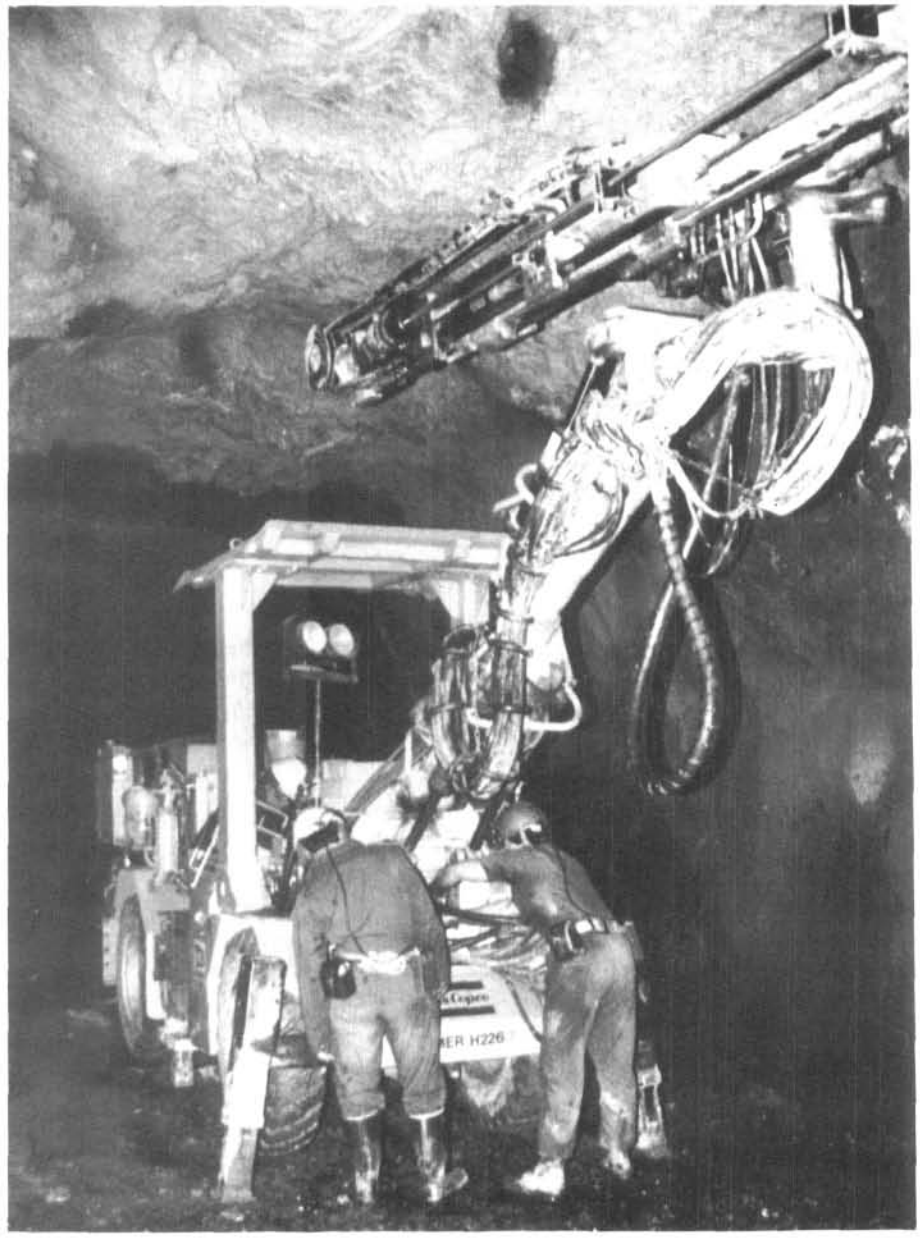


Figure 40. *A jumbo drill in a production stope, Greens Creek mine. Photograph courtesy of Greens Creek Mining Co., 1989.*

Table 12. *Reported sand and gravel production and industry employment in Alaska by region, 1989*

Region	Number of respondents	Amount Stated (tons)	Amount Stated (tonnes)	Total value	of value	Number employees
Northern	3	1,688,167	(1,531,505)	3.75/ton	6,330,626	165
Western	2	2,150,000	(1,950,480)	3.00/ton	6,450,000	35
Eastern/Interior	12	4,577,661	(4,152,854)	2.00/ton	9,155,322	150
Southwestern	2	162,000	(146,966)	3.00/ton	486,000	9
Southcentral	6	4,504,372	(4,086,366)	1.63/ton	7,342,126	160
Alaska Peninsula	1	45,000	(40,824)	1.00/ton	45,000	5
Southeastern	6	1,290,800	(1,171,013)	2.50/ton	3,227,000	101
TOTAL	32	14,418,000	(13,080,008)		33,036,074[a]	625

[a]Approximately $6.9 million was spent on sand-and-gravel, crushed rock, and riprap at Bradley Lake hydroelectric project.

POPO AGIE extracted modest amounts of gravel at their Dry Creek gravel pit near Healy for local road maintenance and pad applications.

DELTA CONCRETE PRODUCTS INC. produced aggregate, crushed rock, and riprap-drain rock at their 267.5-mile Richardson Highway pit near Delta Junction. ALASKA LIMESTONE COMPANY (Jim Caswell) mined, crushed, sized, and bagged limestone from its quarry near Cantwell and sold the bagged product to Anchorage area markets.

SOUTHCENTRAL REGION

An estimated 4.5 million tons of sand-and-gravel and 1.5 million tons of riprap and quarry stone represents an increase of about seven percent from the previous year. The number and size of construction projects in the Anchorage area continues to be influenced by weak economic conditions. Road construction in the Valdez area, and the Bradley Lake hydroelectric project were responsible for the bulk of the industrial mineral mining activities. At Bradley Lake, approximately $6.9 million was spent on sand-and-gravel, crushed rock, and riprap. It was used for road and ramp construction, manufacturing concrete to construct the power house, and dam construction on-site near Homer. The Bradley Lake project is about 65 percent complete, and most of the material-site work is complete. During the work, a large tunnel-boring machine drove a 15-ft-diameter (4.5-m) drift 16,680 ft (5,084 m) as part of the penstock delivering water to the hydroelectric generators; the waste rock for the tunnel was used for riprap and crushed stone applications on the project (fig. 42). The initial 1,800 ft was driven using conventional methods.

The ALASKA RAILROAD hauled 1.65 million tons (1.5 million tonnes) of sand-and-gravel from pits in the Palmer area to Anchorage for use in selected construction projects that

Figure 41. *A dragline with a 6-yd^3 bucket excavates sandy pebble gravel from Earthmovers, Inc. pit on Hanson Road, Fairbanks. Photograph by R.D. Reger, 1989.*

included causeway upgrades at the port and completion of the Anchorage municipal waste facility. ROGERS AND BABLER INC. confined their activities to rock crushing at owner-designated gravel pits that supported their own construction work, and did not specifically mine sand-and-gravel for contract sales, as they have in past years. HERMAN BROTHERS CONSTRUCTION COMPANY mined glacio-fluvial gravels from their LeWalter pit, and marketed sized products for local (Wasilla-Willow) uses.

FAIRWAY GRAVEL produced concrete sand, top soil, pit run sand, and gravel for use in the Soldotna area.

The region's largest sand-and-gravel operation was DOTPF-contracted work for rebuilding 9.2 miles (15 km) of road near Valdez, and for bike trails in the municipality of Valdez. Approximately 800,000 tons (725,760 tonnes) of fill dirt, crushed aggregate, and unclassified rock were utilized on the project.

SOUTHWESTERN REGION

KNIK CONSTRUCTION COMPANY mined 22,000 tons (19,958 tonnes) at Birch Tree Crossing, downstream from Aniak, Alaska. The open pit operation dredged pea gravels from sand bars of the Kuskokwim River, which were used for local communities along the Kuskokwim River. CALISTA CORPORATION used 140,000 tons (127,008 tonnes) of undifferentiated sand-and-gravel and stone for construction projects throughout the CALISTA region.

ALASKA PENINSULA

BRISTOL BAY NATIVE CORPORATION mined 45,000 tons (40,824 tonnes) of sand-and-gravel, and crushed rock from the King Salmon airport pit and two Dillingham gravel pits, for unspecified uses in the Dillingham, Naknek Lake area, and along Aleknagik Road.

Figure 42. *The 15-ft-diameter tunnel at Bradley Lake hydroelectric project, near Homer, southcentral Alaska. Photograph courtesy of Ensearch Alaska Services, 1989.*

SOUTHEASTERN REGION

About 1.29 million tons (1.17 million tonnes) of sand-and-gravel, and 1.2 million tons (1.08 million tonnes) of stone were used throughout the Panhandle; a 44 percent reduction from the 2.89 million tons (2.62 million tonnes) of sand-and-gravel, and 1.8 million tons (1.6 million tonnes) of stone used in 1988. Usage in mine construction-related projects near Berners Bay and at the Greens Creek mine dropped significantly, which is the main reason for the decline. Alaska's DOTPF estimated that about 350,000 tons (317,520 tonnes) of aggregate were used on road construction projects in the Haines, Sitka, Juneau, and Ketchikan areas. The U.S. Forest Service stated that most stone and gravel use was concentrated in the Stikine area of the Tongass National Forest. The Forest Service built 16.9 miles (27 km) of road, using 331,400 tons (300,646 tonnes) of pit-run quarry rock; reconstructed 4.7 miles (7 km) of road with 19,700 tons (17,871 tonnes); and sold through material sales about 5,600 tons (5,080 tonnes) in the Petersburg area. ROCK N ROAD CONSTRUCTION was also active in the quarry business near Petersburg, but details of this operation were not disclosed.

Long-time Juneau producer HILDRE SAND & GRAVEL and lessee JUNEAU READY-MIX produced 31,000 tons (28,123 tonnes) of sand-and-gravel from their Lemon Creek pits north of Juneau, a 50 percent reduction from the previous year. The City of Thorne Bay quarried 27,165 tons (24,644 tonnes) of rock worth $330,000 using lessee ROSDELL CONSTRUCTION COMPANY. McGRAW GRAVEL SALES, INC. quarried modest amounts of stone from their quarry near Sitka, Alaska. NORTHERN TIMBER CORPORATION purchased 1,235 tons (1,120 tonnes) of rock for stream riprap from the University of Alaska's Sunshine Mountain Road quarry near Haines.

The City of Ketchikan quarried 86,870 tons (78,808 tonnes) of shot rock and aggregate for use on municipal roads, and at the Ketchikan International Airport.

COAL AND PEAT

USIBELLI COAL MINE, INC., Alaska's only producer of coal in 1989, sold 705,258 tons (639,810 tonnes) to the KOREAN ELECTRIC POWER COMPANY (KEPCO) in Honan, Korea, through the SUN EEL SHIPPING COMPANY terminal at the Port of Seward in southcentral Alaska. USIBELLI also marketed modest quantities of home heating coal in the Fairbanks area, and fueled six interior power plants with 747,095 tons (677,764 tonnes) for an overall total production of 1,452,353 tons (1,317,574 tonnes), a six percent decrease from the previous year (table 13). The

KOREAN ELECTRIC POWER COMPANY contract allows for coal shipments to range from 680,000- to 920,000-tons (616,900- to 834,625 tonnes); 1989 shipments reflect the lower end of the range. USIBELLI's reclamation program was highlighted in Jackson (1990) (fig. 43).

During the year, 145 trains, each carrying 5,100- to 5,500-tons (4,626- to 4,989-tonnes), unloaded subbituminous coal at the 3-million-tonne-per-year Seward Coal Terminal. The terminal was built by public and private funds in 1984 and is operated by SUN EEL SHIPPING COMPANY.

In 1989, USIBELLI pursued two parallel projects aimed at diversifying their mine operation and improving environmental conditions for coal production and utilization in the future. The USIBELLI Coal Benefication Project is an ongoing project aimed at improving domestic and export marketability of the subbituminous-C coals currently being exploited in the Miocene coal field. The subbituminous coals mined at Healy contain low sulfur and moderate ash, but have high moisture content (up to 25 percent); in other words for every four tons of coal shipped, one ton is essentially water. Removing moisture would increase heating value and enhance export marketability. USIBELLI has committed $100,000 toward investigating the effectiveness of thermal and mechanical drying processes on coals from the Healy coal field. Between 1986 and 1989, USIBELLI coal samples were tested in beneficiation plants in the U.S. and Canada. The University of Alaska, Mineral Industry Research Laboratory (MIRL) tested high pressure drying techniques. In 1989, STONE & WEBSTER ENGINEERING CORPORATION analyzed test results, economic, and technical aspects of the project, and concluded that thermal drying technology had not been sufficiently developed to meet the requirements of USIBELLI's marketing needs. In addition, STONE & WEBSTER suggested that a coal drying beneficiation process should not be included with the proposed Healy Cogeneration Project (HCP), but that USIBELLI should instead proceed on a parallel path using process heat from the HCP as a pilot beneficiation plant.

The Healy Cogeneration Project (HCP) is a proposal to introduce new coal burning technology for the burning of low-sulfur Alaska coal (fig. 44). Successful application of these new technologies should result in one of the cleanest coal-burning plants in the world. In August, 1989, the Alaska Industrial Development and Export Authority (AIDEA) submitted the HCP proposal to the U.S. Department of Energy (DOE) under the Federal Clean Coal Technology program. In December, 1989, the HCP proposal received a grant funding of up to $93.2 million toward construction of a power plant expected to be operational by December, 1995--with a one-year start-up and test program to follow. The HCP proposal was one of 13

Table 13. *Market breakdown for 1989, Usibelli Coal Mine, Healy, Alaska*[a]

Buyer	Coal (tons)	Coal (tonnes)
Domestic		
Alaska Railroad	1,653	1,500
Clear Air Force Base	82,628	74,960
Eielson Air Force Base	152,851	138,666
Fort Wainwright (U.S. Army)	170,198	154,403
Golden Valley Electric Association	154,649	140,297
Fairbanks Municipal Utilities System	123,437	111,982
University of Alaska Fairbanks	55,053	49,944
Reliable Coal (Healy)	6,626	6,011
Subtotal	747,095	677,764
Export		
Korean Electric Power Company (through Suneel Shipping Co.)	705,258	639,810
Subtotal	705,258	639,810
TOTAL	1,452,353	1,317,574

[a]Information provided by C.B. Green, Usibelli Coal Mine, Inc., Fairbanks, Alaska.

Figure 43. *Dall sheep on reclaimed coal mine spoils, Healy. Photograph courtesy of Usibelli Coal Mine, Inc., 1989.*

selected among 48 others received throughout the United States.

If built, the HCP power plant is expected to provide 50 megawatts of electricity using state-of-the art entrained coal combustion (ECC) technology developed by TRW COMBUSTION BUSINESS UNIT, and spray-dryer-absorber (SDA) technology developed by JOY TECHNOLOGIES, INC. The ECC technology allows for removal of 80 percent of the coal's ash prior to the boiler feed. This allows the combustion technology to be used with boilers designed for other fuels. Additionally, limestone is injected into the combustion gases, which removes sulfur dioxide. The SDA emission control system further reduces sulfur dioxide levels in the flue gases (Green, 1990).

Figure 44. *Current 25-megawatt-rated mine mouth power plant, owned and operated by Golden Valley Electric Association. Photograph by Scott Ray, 1989.*

Project participants include: the Alaska Industrial Development and Export Authority (AIDEA), who will be the owner of the HCP project, and will finance project costs; GOLDEN VALLEY ELECTRIC ASSOCIATION, who will operate and maintain the HCP power plant, and purchase electricity from the project; USIBELLI COAL MINE, INC. (UCM), who will supply coal, and make land available for the project; STONE & WEBSTER ENGINEERING, who will provide construction and maintenance services to AIDEA; TRW COMBUSTION BUSINESS UNIT, who will provide combustion technologies, warranties, and performance guarantees for TRW equipment; and JOY TECHNOLOGIES, who will provide sulfur and ash removal technologies, warranties, and who will guarantee their equipment.

In order for the project to move forward, the Alaska legislature must assist in the overall financial plan of the project, to the amount of a $30 million matching grant; additional funds will be raised through various private financial means. Legislative action is expected to be forthcoming in 1990. [Note (in press): The $30 million was approved by the Alaska Legislature.]

Horticultural peat production in 1989 was estimated to be 51,000 yd^3 (38,995 m^3) with a value of $352,000. The majority of production occurred in the Fairbanks area from pits owned by the University of Alaska.

MINERAL PRODUCTION IN YUKON TERRITORY AND BRITISH COLUMBIA THAT AFFECT ALASKA'S ECONOMY

Mineral production in Alaska's neighbor, Yukon Territory, was estimated to be worth $465 million in 1989 and was the Territory's most valuable industry during the year (Staff, 1990). CURRAGH RESOURCES INC. again operated the Faro open pit mine in central Yukon and mined 4,391,062 tonnes of massive sulfide ore at a rate of 12,000 tonnes per day (loc. 5, fig. 15). The company shipped 108,143 tonnes of lead, 116,831 tonnes of zinc, and 95,428 kg (3,067,978 ounces) of silver in concentrate form to Canadian and overseas markets through the Alaskan Port of Skagway (figs. 45 and 46).

The mine was the world's largest zinc producer in 1989, but this distinction is expected to be superseded by Alaska's Red Dog Project in 1990. Although the Faro deposit has only 18-24 months of remaining reserves, the company is agressively developing the nearby 6-million-tonne, Vangorda zinc-lead deposit. CURRAGH completed a 100,000 tonne bulk sample test at the Faro mill late in 1989. Prestripping of overburden of the 25-million-tonne Grum deposit was also begun in 1989, ensuring concentrator feed for the Faro mill into the early 21st century.

The Yukon's only lode gold mine was operated by CANAMAX RESOURCES INC. at Ketza River in the Tintina trough southeast of Faro. The company processed 141,148 tonnes of ore from both underground and open-pit reserves, and produced 1,216 kg (39,094 ounces) of gold, and 74.6 kg (2,398 ounces) of silver. The company had reserves totaling 120,000 tonnes

grading 12 g/tonne gold at the end of 1989.

Yukon placer mining industry gold production was 165,571 raw ounces (5,149 kg), about the same level of production as the 161,000 ounces produced in 1988. Many of Yukon's placer mines are accessed in part by transportation systems in Alaska, and many operators formerly mined in Alaska. Production is derived from 220 small family or company operations that employ 800 people during the five- to six-month mining season. Most placer mines operated in the Dawson district and the Indian River subdistrict, producing 80,000 ounces (2,488 kg) or 48 percent of Yukon's total placer output. The last time 1989's production was exceeded was in 1917 when 13 dredges and many hydraulic operations were active. A single dredge operated during most of the 1980's in Clear Creek (fig. 47). Modern placer operations take advantage of new D-10 and D9L tractors to move overburden and pay. The ability of earth-moving equipment to rip permafrost has greatly accelerated preparation of ground for mining in comparison to previous activities.

Figure 45. *Swedish designed concentrate containers aboard semi-tractor trailer at Skagway, southeastern Alaska. Photograph by T.K. Bundtzen, 1989.*

Figure 46. *Redesigned concentrate loading facility at Skagway, owned and operated by Curragh Resources. Photograph by T.K. Bundtzen, 1989.*

The only operating mine in the "Golden Triangle" area of British Columbia is the Johnny Mountain mine of SKYLINE GOLD CORPORATION which mined 79,469 tonnes of ore grading 0.66 oz/ton (22.6 g/tonne) gold with significant byproduct copper and silver. This mine was supplied by airlift from the town of Wrangell, and the economic impact has been carefully documented by the city.

In 1989 approximately 16.71 million pounds (7.6 million kg) of fuel, equipment, and supplies were airlifted out of Wrangell into the "Golden Triangle," and about 7.03 million pounds (3.2 million kg) were backhauled out. Local purchases are estimated to be $3.3 million, up 65 percent from 1988, and a total of 7,372 flights to Canada originated in Wrangell, an increase of 17 percent over 1988. About 25 new jobs were created in the town because of this activity, and three businesses, WHITE PASS OIL, BRADFIELD ELECTRIC CORP., and SKYLINE NORTHERN EXPEDITING, were started.

Hyder, in extreme southeast Alaska, could find an impact similar to that in Wrangell because of the renewed activity in the Stewart area of British Columbia. A 2,000 tonne-per-day mill at WESTMIN MINES LTD.'s Premier gold mine is receiving feed from the old Silbak Premier and Big Missouri properties. By October 1989 almost 60,000 tonnes with an average grade of 0.074 oz/ton (2.5 g/tonne) gold had been milled. The mineralization occurs in pyroclastics and sediments of the Lower-Jurassic Hazelton Group.

Figure 47. *Queenstake dredge mothballed at Clear Creek, Yukon Territory. Photograph by Steve Morison, 1989.*

DRILLING ACTIVITY IN 1989

INTRODUCTION

Seventeen companies conducted significant drilling programs in Alaska in 1989, 12 less than in 1988, and the total footage declined from 832,000 ft (253,594 m) in 1988 to 678,150 ft (206,700 m) in 1989 (table 14). The decline was mainly in placer drilling, particularly in thaw-field drilling. Table 15 lists the companies involved.

In this report table 14 differentiates between placer exploration drilling and thaw-field drilling ahead of placer mining. In the hard-rock category rotary or reverse-circulation drilling is separated from diamond drilling which produces a core. In addition to the total amount of drilling reported in table 14, about 550,000 ft (167,640 m) of blasthole drilling was associated with production at four operating mines. For the first time a significant tunnel was driven in Alaska using a 160-ton tunnel-boring machine at the Bradley Lake hydroelectric project near Homer. This technology might be adaptable to mining projects.

PLACER DRILLING

In 1989 placer exploration drilling declined from the 1988 footage by

Table 14. *Drill footage in Alaska 1982-89*

	1982		1983		1984		1985	
	(feet)	(meters)	(feet)	(meters)	(feet)	(meters)	(feet)	(meters)
Placer	30,000	9,144	23,000	7,010	31,000	9,448	46,000	14,020
Placer thawfield	94,000	28,651	30,000	9,144	98,000	29,870	34,000	10,363
Placer total	124,000	37,795	53,000	16,154	129,000	39,319	80,000	24,384
Coal	80,000	24,384	12,000	3,657	25,700	7,833	8,700	2,651
Hard-rock total	200,000	60,960	180,500	55,016	176,000	53,644	131,700	40,142
Hard-rock (core)	-[a]	-	-	-	-	-	-	-
Hard-rock (rotary)	-	-	-	-	-	-	-	-
TOTAL[b]	404,000	123,139	245,500	74,828	330,700	100,797	220,400	67,177

	1986		1987		1988		1989	
	(feet)	(meters)	(feet)	(meters)	(feet)	(meters)	(feet)	(meters)
Placer	32,400	9,875	50,250	15,316	152,000	46,329	97,250	29,641
Placer thawfield	227,000	69,189	130,000	39,624	300,000	91,440	210,000	64,008
Placer total	259,400	79,065	180,250	54,940	452,000	137,769	307,250	93,649
Coal	28,800	8,778	19,900	6,065	26,150	7,970	38,670	11,786
Hard-rock total	50,200	15,300	115,100	35,082	353,850	107,853	332,230	101,263
Hard-rock (core)	-	-	95,600	29,138	223,630	68,162	242,440	73,895
Hard-rock (rotary)	-	-	19,500	5,943	130,220	39,691	89,790	27,368
TOTAL[b]	338,400	103,144	315,250	96,088	832,000	253,593	678,150	206,700

[a]Not differentiated.

[b]Some annual totals are updated from prior years.
1989 blasthole drilling, 548,140 feet (167,073 m), not included in table 14.
Approximately 16,680 feet (5,084 m) of 15-foot diameter tunnel at Bradley Lake hydroelectric project driven by a tunnel-boring machine.

Table 15. *Companies reporting significant drilling projects in 1989*

Alaska Apollo Gold Mines Ltd.
Alaska Gold Company
AMAX Gold Exploration Inc.
Battle Mountain Gold Company
Cominco-Alaska Exploration
Coeur D'Alene Mine
Echo Bay Mines
Fairbanks Gold Ltd.
Idemitsu Alaska Inc.
International Curator Resources Ltd.
Kennecott Greens Creek
Palomar Capital Corp.
Placer Dome U.S. Inc.
Tri-Con Mining, Inc.
Usibelli Coal Mine, Inc.
Valdez Creek Mining Co.
Western Gold & Exploration

36 percent to 97,250 ft (29,641 m), and thaw-field drilling declined by 30 percent to 210,000 ft (64,008 m). An additional 370,000 ft (112,776 m) of blastholes for stripping frozen placers was drilled near Fairbanks and at the Denali mine.

The largest reported placer exploration project was the 31,500 ft (9,601 m) of rotary drilling by the VALDEZ CREEK MINING COMPANY at their Denali mine in the Susitna headwaters of southcentral Alaska, but as in 1988 there were substantial placer exploration drilling projects onshore and offshore at Nome by ALASKA GOLD COMPANY and WESTGOLD respectively.

All of the 210,000 ft (64,008 m) of thaw-field drilling was for the ALASKA GOLD COMPANY's upland dredging operations just outside of the town of Nome.

COAL DRILLING

For the second consecutive year, coal exploration drilling increased. All of the 38,670 ft (11,786 m) drilled in 1989, a 48 percent increase over 1988, was by rotary drilling, with the exception of 780 ft (238 m) of diamond drilling at Wishbone Hill.

USIBELLI COAL MINE, INC. drilled 12,000 ft (3,658 m) of exploration holes in the Hoseanna Creek area of their leases, and 7,700 ft (2,347 m) of development drilling in the same area. An additional 140,677 ft (42,878 m) of blasthole drilling was done in 1989.

Further south MT. McKINLEY MINING drilled almost 1,400 ft (427 m) of rotary exploratory holes and 780 ft (238 m) of diamond drill holes to further the exploration of the Wishbone Hill project on behalf of IDEMITSU ALASKA INC.

HOBBS INDUSTRIES INC. drilled almost 2,000 ft (610 m) at their Castle Mountain coal project using a reverse circulation rotary rig.

HARD-ROCK DRILLING

The total amount of hard-rock drilling in 1989, 332,230 ft (101,264 m), was down 21,620 ft (6,590 m) from the 1988 revised total of 353,850 ft (107,853 m), a decline of 6 percent. About 26,480 ft (8,071 m) of the 1989 drilling was diamond drilling associated with production and development, and the remaining 305,760 ft (93,196 m) is classified as exploration. Unlike 1988, when 57 percent of the hard-rock exploratory drilling was core drilling, almost 216,000 ft (65,837 m), or about 71 percent of the 1989 exploration footage, was core drilling, with the remainder being rotary drilling. This change reflects the advanced stage of the exploration at several properties, particularly near Juneau.

Of the 17 companies listed in table 15, three are primarily involved with placer projects, two with coal, and the remaining 12 with hard-rock projects. Only two of the 12 are concerned with base metals, and so 10 of 17, or 59 percent, are primarily oriented toward the precious metals.

Tunnel-boring machines are not commonly used in Alaska, so the use of a 160-ton, 15-ft-diameter boring machine at the Bradley Lake hydroelectric project during 1989 may represent a step into the future. The machine set two world records for it's class, driving 275 ft (83.8 m) in a day, and 116 ft (35.3 m) in an 8-hour shift. Approximately 16,680 ft (5,084 m) of tunnel was drilled in 1989, about three to four times faster than with conventional methods. Smaller and more maneuverable machines are also available, and may significantly change the pace of tunnelling and the attitude toward tunnelling.

METAL RECYCLING INDUSTRY IN 1989

At least nineteen companies in the Fairbanks, Anchorage, Kenai, Juneau, and Ketchikan areas remined, baled, and shipped 7,638,000 pounds (3.41 million kg) of base metal and composite alloy scrap and 48 million pounds (21.78 million kg) of ferrous scrap worth $8.7 million, to "lower 48" and Pacific Rim processing plants. Product volume increased significantly from 1988-89 but overall dollar value estimates represent a 14 percent decrease from the previous year (1988) despite increasing interest and public awareness of all aspects of material recycling (table 16).

As in 1987 and 1988, many small and several larger companies declined to submit weight and value figures for their exported metal products and statewide canvassing was incomplete (table 17). As a result, the weight estimates in table 16 are understated. At least 185 persons were employed in the recycling industry.

The reasons for the overall value decline in the industry was mainly

Table 16. *Scrap metal and glass exports from Alaska 1987-89*[a]

Commodity	1987 Quantity (lbs)	1987 Quantity (kg)	1987 Value ($)	1988 Quantity (lbs)	1988 Quantity (kg)	1988 Value ($)	1989 Quantity (lbs)	1989 Quantity (kg)	1989 Value ($)
Copper-brass	1,789,680	811,988	2,147,616	1,512,930	686,265	2,345,041	1,250,000	567,000	1,437,500
Aluminum	1,165,960	528,879	1,748,940	2,394,607	1,086,193	2,993,259	2,900,000	1,315,440	2,175,000
Stainless steel	45,000	20,412	292,500	240,350	109,022	1,191,793	NR	NR	NR
Car radiators	NR	NR	NR	120,354	54,592	1,481,416	275,000	162,880	1,100,000
Zinc	NR	NR	NR	21,684	9,836	16,263	NR	NR	NR
Lead	474,800	215,369	189,920	94,500	42,865	37,800	1,208,000	547,488	507,360
Nickel-cobalt alloys	25,000	11,340	200,000	4,800	2,177	48,000	NR	NR	NR
Non-ferrous undistributed	NR	NR	NR	NR	NR	NR	1,480,000	671,328	NR
Ferrous scrap	90,000,000	40,824,000	3,825,000	28,023,000	12,711,232	1,401,000	48,000,000	21,772,800	2,900,000
Glass	NR	NR	NR	600,000	272,160	6,000	833,900	378,257	8,340
TOTAL			$8,403,976			$9,520,572			$8,128,200

[a]1987 and 1988 information from Bundtzen and others (1988) and Green and others (1989). 1989 estimates from 19 metal recycling companies; four from Fairbanks; five from Anchorage; one from Wasilla; two from Kenai-Soldotna; and four from southeast Alaska.

[b]Value estimates based on 1989 average metal commodity prices: copper ($1.15/lb); aluminum ($0.75/lb); stainless steel ($5/lb); zinc ($0.68/lb); radiator value ($4/lb); lead ($0.42/lb); nickel/cobalt alloys ($4/lb); and glass ($0.01/lb).

lower overall metal prices. Prices for many non-ferrous metals dropped as much as 50 percent from 1988, which greatly limited the profitability of exporting recycled scrap. The economic effects of the Exxon Valdez oil spill, which diverted labor and efforts from several larger recycling companies was also a negative factor.

Iron scrap exports showed a significant gain from 1988 to 1989 but aluminum output was about the same level as 1988 at 2.9 million pounds (1.31 million kg) in 1989. Lead showed the largest gain of any commodity--from 475,000 pounds (215,369 kg) in 1987 to 1.21 million pounds (547,488 kg) in 1989, a 250 percent increase over the two year period (1988 lead weight estimates are judged to be too incomplete for accurate yearly comparisons).

K&K RECYCLING of Fairbanks accounted for about 20 percent of total base metal scrap exports statewide and was the Interior's largest dealer for all recycled metals in 1989. K&K ships scrap to both "lower 48" vendors and Pacific Rim buyers. However, K&K was actively involved in subcontractual work related to the Exxon Valdez oil spill as well as increasing its diversity in interior Alaska timber sales. Consequently K&K put less emphasis on the metal scrap business than in previous years.

Aluminum can recycling increased in the general Fairbanks area in 1989. Crews working on the interior city's annual clean-up campaign reported significantly fewer aluminum cans along roadways.

ALUM RECYCLING reported a 80 percent increase in shipments of baled aluminum cans over 1988 weights.

SANDY'S RECYCLING of Fairbanks shipped aluminum, copper, and car radiators and initiated the first recycling program for bottle glass in the Fairbanks area. Most of SANDY'S scrap metal and glass shipments are combined with those of the ANCHORAGE RECYCLING CENTER in Anchorage (ARC). ARC continued to operate its high density bailer, and processed most non-ferrous scrap from the Anchorage area but 1989 shipments were down significantly from those of 1988. Unfortunately glass recycling is presently sub-economic and long term expansion of these activities will rely on increasing commodity prices, government subsidies, or development of viable local uses. Glass use as a filler in D-1 asphalt is being examined by state and local municipal officials.

ALASKAN BATTERY SUPPLY (ABS) of Fairbanks shipped five to eight containers monthly of spent lead-based auto batteries to West Coast reprocessing facilities. ABS indicated that business picked up from 1988 to 1989 because of high market prices for lead.

About 70 percent of the total statewide export of base and ferrous metal scrap came from Anchorage, Wasilla, Willow, and the Kenai-Soldotna areas. Quantity decreased from 1988 levels; most respondents to our inquires indicated that the economic effects of the Exxon Valdez oil spill and lower metal prices caused the decrease. The oil spill caused locally acute labor shortages and shipping containers were scarce to nonexistent throughout most of the six month oil spill clean-up period.

Table 17. *Selected companies that export scrap metal and glass from Alaska, 1989*[a]

Company	Commodities recycled
(Fairbanks)	
(K&K Recycling	Aluminum, copper, brass, ferrous scrap, nickel-cobalt alloys
Alum Recycling	Aluminum
Sandy's Recycling	Aluminum, glass, miscellaneous non-ferrous, radiators
Alaskan Battery Supply	Lead-based batteries
(Anchorage)	
Anchorage Recycling Center	Aluminum, glass, copper, brass, nickel-cobalt alloys
Prescott Equipment	Ferrous and non-ferrous scrap
Battery Specialists Inc.	Lead-based batteries
Alaska Metals recycling	Ferrous and non-ferrous scrap
Standard Steel and Metals	Ferrous scrap
Staino Steel	Stainless steel, miscellaneous scrap
M&M Company	Ferrous and non-ferrous scrap
ARCO Alaska	Ferrous scrap
(Kenai-Soldotna)	
Tuttle Inc.	Miscellaneous scrap
Hutton Enterprises	Miscellaneous scrap
(Juneau)	
E&L Auto Body	Aluminum, lead-based batteries, auto bodies, radiators
Auke Bay Cans	Aluminum, copper, brass, lead, zinc
North Tongass Salvage	Ferrous and non-ferrous scrap
Channel Sanitation	Aluminum, lead-based batteries
(Ketchikan)	
Jim Church	Non-ferrous scrap, auto bodies

[a]1989 information from 19 metal recycling companies.

Companies active in the general Anchorage area are summarized in table 17.

ALASKA METAL RECYCLING continued to operate its Anchorage-based metal shredder, which was installed in 1987. The company overcame operational problems encountered in 1988 and resumed full scale production in 1989. The company processed and baled nearly 16,000 tons (14,515 tonnes) of car bodies, I-beams, and structural steel and shipped them to parent company NEWELL RECYCLING, of San Antonio, Texas for final remanufacture into saleable products.

ARCO ALASKA INC. organized "Operation Scraplift" and shipped 6,000 tons (5,443 tonnes) of junked vehicles, buildings, pipe, and drill rig components from the North Slope to GENERAL METALS, one of the largest scrap dealers on the West Coast. The effort was completed by ARCO and over 20 oil field service companies that work on the North Slope. ARCO ALASKA, BP EXPLORATION, and EXXON provided the service contractors with access to two ocean-going barges and use of the West Dock facilities. ARCO ALASKA previously shipped 13,500 tons (12,247 tonnes) of scrap metal from the North Slope to West Coast salvage yards in 1979 and 1987. However, the 1989 effort was the first time service industry companies were actively engaged in scrap collections.

Five Juneau-based companies and one from Ketchikan shipped scrap batteries and car bodies from southeast Alaska. None of these companies were included in our 1987 and 1988 surveys. Juneau's largest recycling company, E&L AUTO BODY, baled and shipped auto bodies, lead batteries, aluminum, stainless steel, zinc, and radiators to the Pacific northwest. E&L was contracted to scrap the old Juneau swimming pool and about 15 tons of aluminum were recovered. AUKE BAY CANS and NORTH TONGASS SALVAGE concentrated on aluminum, copper, and brass recycling.

JIM CHURCH of Ketchikan processed and shipped a variety of metallic commodities including car bodies and aluminum from the Ketchikan area despite difficulties caused by lower commodity prices.

MINERAL RESOURCES AND MINERAL POTENTIAL OF LAND OWNED BY NATIVE REGIONAL CORPORATIONS

INTRODUCTION

The Alaska Native Claims Settlement Act (ANCSA), passed in December 1971, provided for the conveyance of approximately 44 million acres (17.8 million hm^2) of land to Alaska natives. Under the terms of ANCSA, 12 landed regional corporations (fig. 48) and Native village corporations within the regions were formed to select and manage the land settlement. The entitlement of each regional corporation is based on land areas covered by the region and on the number of Native corporation stockholders.

Under ANCSA, the village corporations received title to the surface estate of approximately 22 million acres

(8.9 million hm^2). The regional corporations received title to the subsurface estate of the village lands, title to surface and subsurface estates for approximately 16 million additional acres (6.5 million hm^2), and subsurface title for much of 2 million (0.8 million hm^2) acres of special-purpose lands. The balance of the land settlements is for 3.7 million acres (1.5 million hm^2), which comprises the settlement for seven Native village corporations located on five revoked reserves. These seven village corporations hold title to both the surface and subsurface estates of their former reserves, which were created prior to ANCSA.

At the time of this writing approximately 35-1/2 million acres (14.4 million hm^2) have been transferred to the corporations, of which about 8.2 million acres (3.3 million hm^2) are patents to surveyed lands, and the balance, 27.3 million acres (11 million hm^2), are in the form of interim conveyances.

Nine of the 12 landed corporations provided information on their mineral resources and potential for this report.

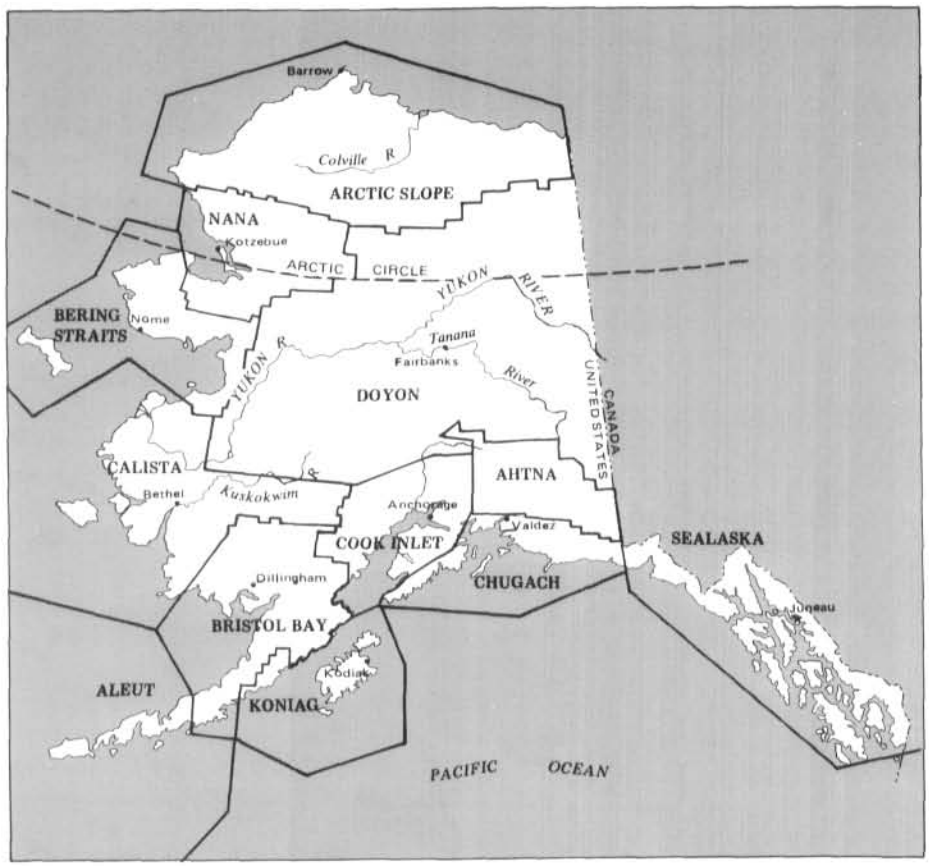


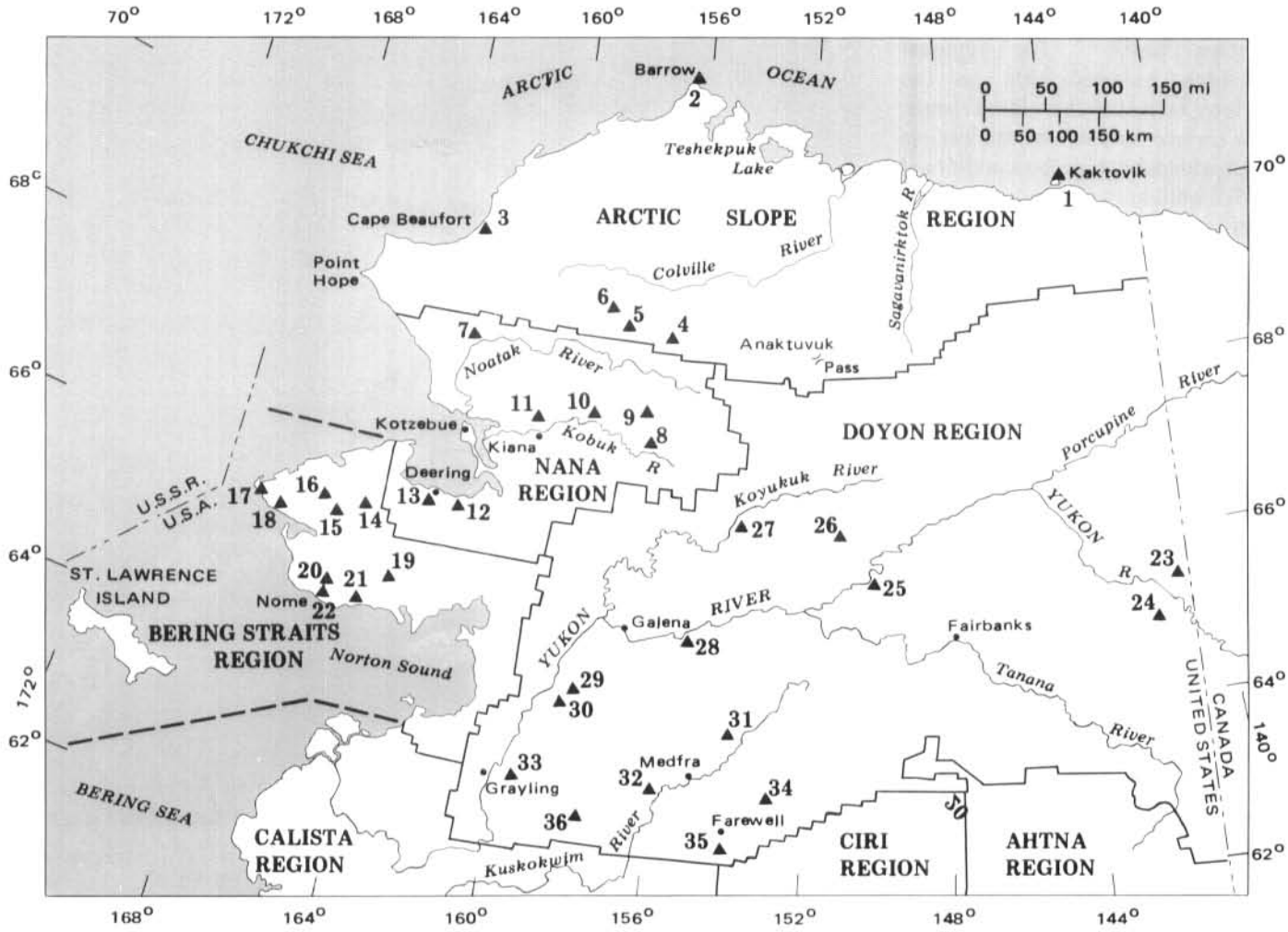
Figure 48. *Native Regional Corporations in Alaska.*

ARCTIC SLOPE REGIONAL CORPORATION

ARCTIC SLOPE REGIONAL CORPORATION (ASRC) is located in northern Alaska (fig. 49), with headquarters in Barrow (loc. 2, fig. 49) and an office in Anchorage. Their land entitlement of 4.7 million acres (1.9 million hm^2) includes mineral rights for coal, oil and gas, sand-and-gravel, and hard-rock minerals. Mineral interests are focused on bituminous coal in the Deadfall syncline area and other coal basins near Cape Beaufort, precious metals, and Red Dog-type zinc-lead-silver mineral deposits in other areas of the Brooks Range.

Bituminous and subbituminous coal reserves of the North Slope are among the largest in the United States (Merritt and Hawley, 1986). ARCTIC SLOPE CONSULTING GROUP (ASCG), a subsidiary of ASRC, has conducted detailed studies of coal reserves in the Deadfall syncline area, and other coal basins on the Chukchi Sea coast (loc. 3, fig. 49). Deadfall syncline coal is of B-A bituminous rank, 13,000 Btu (7,096 kcal/kg), low ash (7.62 percent), and low sulfur (0.19 percent). ASCG recently published studies of the feasibility of producing Western Arctic coal as a local energy source and as an export to Pacific Rim nations. ASCG with the support of MECHANICAL TECHNOLOGIES, INC., BATTELLE MEMORIAL INSTITUTE, NOME JOINT UTILITIES, and the KOTZEBUE ELECTRIC ASSOCIATION, has also proposed the use of Western Arctic coal for power generation in the Nome and Kotzebue areas as part of a recent Department of Energy Clean Coal Technology program.

Significant mineral deposits may exist in the Noatak mining district, a 50-mile-wide (80 km) belt that stretches from Point Hope on the Chukchi Sea east to Anaktuvuk Pass in the northcentral Brooks Range. Known mineral deposits include zinc-lead-silver reserves at Kivliktort Mountain (loc. 4, fig. 49), on Story Creek (loc. 5, fig. 49), and at Drenchwater Creek (loc. 6, fig. 49). ASCG has conducted detailed geological, geophysical, and geochemical surveys at all three of these locations. Assays at these deposits are of outstanding value, including a rock sample assay of 2,090 ppm silver, 59 percent lead, and seven percent zinc at Story Creek, and one rock assay of 13 percent zinc, 6.5 percent lead, and 144 ppm silver at Drenchwater Creek. Three Red Dog-type prospects have been delineated by ASCG at locations approximately 10-15 miles (16-20 km) north of Red Dog mine (loc. 7, fig. 49). These prospects



1. Kaktovik gravel reserves (Arctic Slope)
2. Barrow gravel reserves (Arctic Slope)
3. Deadfall syncline coal deposit (Arctic Slope)
4. Kiviliktort Mountain zinc-lead-silver deposit (Arctic Slope)
5. Story Creek zinc-lead-silver deposit (Arctic Slope)
6. Drenchwater Creek zinc-lead-silver deposit (Arctic Slope)
7. Red Dog zinc-lead-silver deposit (NANA)
8. Cosmos Hills (Bornite) copper-zinc deposit (NANA)
9. Ambler mining district copper-lead-zinc-silver-gold deposit (NANA)
10. Jade Mountains jade deposit (NANA)
11. Klery Creek placer gold deposit (NANA)
12. Chicago Creek coal reserve (NANA)
13. Inmachuk River placer gold deposit (NANA)
14. Kougarok placer gold deposit (Bering Straits)
15. Kougarok tin-tantalum prospect (CIRI)
16. Kelly Creek gold prospect (CIRI)
17. Potato Mountain tin prospect (Bering Straits)
18. Lost River tin-tungsten-fluorite-beryllium deposit (Bering Straits)
19. Council placer gold deposit (Bering Straits
20. Rock Creek (Bering Straits)
21. Solomon placer gold deposit and Big Hurrah mine (Bering Straits)
22. Nome placer gold deposit (Bering Straits)
23. Step Mountain lead-zinc-silver deposit (Doyon)
24. Slate Creek chrysotile-asbestos reserve (Doyon)
25. Rampart mining district gold deposits (Doyon)
26. Kanuti River placer tin deposit (Doyon)
27. Hughes mining district gold-uranium deposits (Doyon)
28. Ruby mining district gold-tin deposits (Doyon)
29. Illinois Creek mining district lead-zinc-silver-copper deposits (CIRI)
30. Waterpump Creek silver-lead-zinc prospect (CIRI)
31. Medfra lead-zinc-silver deposit (Doyon)
32. Candle Creek mining district gold-tungsten-mercury deposits (Doyon)
33. Grayling molybdenum deposit (Doyon)
34. Tonzona coal field (Doyon)
35. Farewell mining district silver-zinc-lead-tungsten deposits (CIRI)
36. Iditarod mining district gold-silver-tungsten-mercury-antimony deposits (Doyon)

Figure 49. *Selected mineral properties held by Arctic Slope, NANA, Bering Straits, Doyon Ltd., and Cook Inlet Region, Inc., Regional Corporations, 1989.*

are of special interest because of their location in the same geologic sequence that hosts Red Dog and proximity to the Red Dog mine infrastructure. The prospects are also located on a proposed 90 mile (144 km) coal-minerals transportation corridor leading north from Red Dog mine to the Deadfall syncline coal deposit.

Gravel resources at ASRC have been used in North Slope oil field development and several large, low-moisture, low-silt gravel reserves have been identified by ASCG near Kaktovik and Nuiqsut. The gravel reserves at Kaktovik are located in the Arctic National Wildlife Refuge on ASRC lands, and have been mined for clients including the NORTH SLOPE BOROUGH, U.S. AIR FORCE, and the KAKTOVIK INUPIAT CORPORATION (KIC). ASRC and KIC now hold a Corps of Engineers permit to extract 1.2-million yd^3 (0.9 million m^3) of gravel for the future gravel needs of Kaktovik clients. These gravel reserves may be of future value to ASRC and the local village corporations (loc. 1, fig. 49).

Additional information on mineral resources of the ASRC region is available from Charles Barnwell, Manager - Resources Division, ARCTIC SLOPE CONSULTING GROUP 6700 Arctic Spur Road, Anchorage, Alaska, 99518-1550 (phone: 907-267-6339).

NANA REGIONAL CORPORATION

NANA REGIONAL CORPORATION (NANA) headquartered in Kotzebue, stretches across 2 million acres (0.8 million hm^2) in western Alaska. NANA owns the Red Dog zinc-lead-silver mine (loc. 7, fig. 49), the Ruby Creek copper deposit at Bornite (loc. 8, fig. 49), and the Stewart jade mine in the Cosmos Hills (loc. 8, fig. 49).

The Red Dog mine, a joint venture between NANA and COMINCO-ALASKA, officially went into production in late 1989. The mine, operated by COMINCO-ALASKA, is an open pit with proven reserves of 85 million tons (77 million tonnes). The ore grades 17 percent zinc, 5 percent lead, and 2.4 oz/ton (82 g/tonne) silver. Ore concentrate is hauled overland to a storage area on the coast and stockpiled for shipping. The shipping season extends from July through mid-October.

The NANA region has the potential for hosting economic deposits of both base and precious metals. The Cosmos Hills and the southern flank of the Brooks Range contain significant copper lode deposits such as the Bornite deposit at Ruby Creek (loc. 8, fig. 49), Arctic (loc. 9, fig. 49), and the remainder of the Ambler district. The region also encompasses several historic placer gold regions, some of which are still active. These include the South Cosmos Hills (loc. 8, fig. 49), Klery Creek (loc. 11, fig. 49), the Inmachuk and the Kugruk drainages (loc. 13, fig. 49). There is reasonable lode gold potential in these regions in light of the recent discoveries made in the Nome area.

NANA is in the process of locating and documenting potential fossil fuel resources within the region. The fossil fuels may have potential for development as a fuel source for nearby villages. The Chicago Creek coal deposit (loc. 12, fig. 49), evaluated several years ago under a state-supported program, was determined to be of sufficient grade and extent to be used for heat, power, and economic development. Significant thicknesses of coal have also been encountered near Selawik. Little is known about the quality or extent of these resources but further work is justified.

NANA owns the old Empire jade mine (loc. 10, fig. 49) in the southern portion of the Jade Mountains. A large tonnage of jade of the nephrite variety is still in place. NANA also recently acquired the Stewart jade mine which is comprised of two separate claim blocks in the Cosmos Hills. Significant jade reserves are present on these properties also. The jade is cut and polished in Kotzebue by Jade Mountain Products, a NANA subsidiary.

Over the past three years NANA has funded a geological and geochemical reconnaissance program to systematically evaluate the mineral potential of their land selections. The program is ongoing and will probably expand onto conveyed lands in the future.

The NANA region has substantial gravel reserves. Every major river valley contains gravel and every village has a nearby gravel source to meet local needs.

Additional information on the mineral resources of the NANA region is available from John Rense, Vice President-Resources, NANA Regional Corporation, 4706 Harding Drive, Anchorage, Alaska 99517 (phone: 907-248-3030).

BERING STRAITS NATIVE CORPORATION

BERING STRAITS NATIVE CORPORATION (BSNC) has a land entitlement of 2.243 million acres (0.9 million hm^2) within two distinct geologic terranes on the Seward Peninsula and in the Yukon-Koyukuk area. The corporation has headquarters in Nome and an office in Anchorage.

The Nome area (loc. 22, fig. 49) is historically one of Alaska's primary gold-producing regions. Since the discovery of gold on Anvil Creek in 1898, at least 4.8 million ounces (149,300 kg) of placer gold have been produced. Other placer deposits in the BSNC region at Council (loc. 19, fig. 49), and Kougarok (loc. 14, fig. 49) areas have produced substantial quantities of gold and there is good potential for the discovery of additional placer deposits. Pay channels delineated by previous exploration work and tailings from prior placer mining operations may represent additional economic reserves.

Recent work in the BSNC region has been concentrated in areas where there is hard-rock source potential for the numerous gold placer occurrences, notably in the Nome, Solomon-Bluff, Kougarok, Council, Koyuk, Port Clarence, and Ungalik River areas. Gold-bearing veins and associated disseminated mineralization have been found at Rock Creek (loc. 20, fig. 49) and Mt. Distin (loc. 20, fig. 49), 6 and 25 miles (10 and 40 km) north of Nome, respectively, and at Bluff 50 miles (80 km) east of Nome. The Big Hurrah mine (loc. 21, fig. 49), north of Solomon was the only significant producer of lode gold (10,000 oz; 311 kg), and has estimated reserves of about 500,000 tons (453,600 tonnes) at a grade of approximately 0.40 oz/ton (170 g/tonne). Potential for the development of further reserves in veins in the York Slate bedrock is considered to be good. The Big Hurrah gold mine is undergoing active development by joint venture partners GOLDEN ZONE RESOURCES and STRATFORD AMERICAN RESOURCE CORPORATION with operator SOLOMON GOLD CORPORATION. A state-of-the-art conventional vat leach-flotation circuit mill is planned.

At Bluff, where BHP-UTAH INTERNATIONAL INC. conducted investigation on BSNC lands, gold mineralization occurs in mica schist in contact with a thick-bedded marble unit. In the creek placers downstream of the source the gold was superconcentrated in rills and potholes in the limestone and marble. Though such deposits can be difficult to delineate, the rewards can be substantial, and the beaches offshore of Bluff contained some of the richest placer deposits ever found.

Considerable work has recently been accomplished at Rock Creek, where ASPEN EXPLORATION CORP., until recently supported by PLACER DOME U.S., outlined 6.6 million tons (6 million tonnes) of gold-bearing rock with a grade of 0.07 oz/ton (2.4 g/tonne) in quartz veins and stringers in a sheared graphite-biotite schist. ASPEN recently announced an option agreement with TENNECO MINERALS INC. to explore the Anvil Creek area just south of Rock Creek.

At Mt. Distin a tabular silicified body in the transition zone between a chloritic schist and a massive carbonate unit contains arsenopyrite-pyrite-stibnite-gold mineralization. The tabular body is in turn cut by veins containing arsenopyrite, stibnite, and gold.

About 6.5 million pounds (2,948,400 kg) of tin has been produced from veins, disseminated deposits and placers throughout the Seward Peninsula, and one of the largest tin reserves in North America occurs at Lost River (loc. 18, fig. 49).

Lode tin associated with peraluminous biotite granite rocks occurs at Cape Mountain and Potato Mountain (loc. 17, fig. 49), Brooks Mountain, Lost River, and Black Mountain (loc. 18, fig. 49) and in the Oonatut granite complex. Common modes of occurrence include veins of cassiterite and stannite associated with greisenized rhyolite dikes, mineralized skarns in limestones above granitic cupolas, and greisenized parts of granitic stocks. Fluorite, beryllium minerals, silver sulphosalts and sulphide minerals are common associates. Several of the deposits are barely exposed by erosion, and at Potato Mountain the top of the granite, according to gravity and magnetic data, is still 1,300 ft (396 m) underground, and so if cassiterite is concentrated above the granite as is common elsewhere, the reserve is basically intact.

SOUND QUARRY, INC., a subsidiary of BSNC and SITNASUAK NATIVE CORPORATION, is actively developing a rock quarry at Cape Nome, 13 miles (21 km) east of Nome. The rock at Cape Nome is a gneissic granite and coarse-grained to porphyritic biotite granite with a degradation value of 75. The Cape Nome rock meets the Corps of Engineers specifications for armor rock and it was used in the construction of several ports and causeways in western Alaska. The known outcrop area of the granitic rock is nearly 1 mile^2 (2.6 km^2) and is accessible by road and a small deep water loading facility.

BSNC completed Chapter 11 reorganization on January 23, 1989 and now, for the first time since early 1986, is actively seeking to develop the extensive mineral deposits on it's lands. Additional information on mineral resources of the BERING STRAITS region is available from Jeff Burton, Vice President, Land & Resources, BERING STRAITS NATIVE CORPORATION, P.O. Box 1008, Nome, Alaska 99762 (phone (907) 443-5252).

DOYON, LTD.

The land entitlement for DOYON, LTD., includes approximately 12.5 million acres (5 million hm^2) with mineral rights. The DOYON region, which encompasses approximately one-third of Alaska (fig. 49), extends from the Brooks Range on the north to the Alaska Range on the south, and from the Alaska-Yukon border almost to Norton Sound. DOYON headquarters are located in Fairbanks.

Exploration programs conducted on DOYON land since 1975 have identified several hundred prospects and generated an extensive minerals data base. These programs have been conducted by DOYON and by a number of major international mining companies under agreements with DOYON. Early programs provided a regional reconnaissance of DOYON land, leading to drilling targets and development work. The data and samples from those programs have been retained, and have been used to define additional targets. Several major new mineral districts have been identified through these programs.

During the last several years DOYON has encouraged mineral

exploration on it's lands through preparation of data packages reflective of mineral industry interests, actively meeting with mining companies throughout North America, and in several other countries. This has resulted in exploration agreements with AMERICAN COPPER AND NICKEL, PLACER DOME U.S., CAITHNESS ALASKA MINING COMPANY, and ELECTRUM covering several million acres. Expenditures since 1986 have exceeded $8 million, largely directed at gold exploration, with drilling conducted on a number of targets. DOYON continues to conduct exploration and expects to generate additional targets of interest to industry.

DOYON lands contain a broad range of geologic environments with recognized mineral potential. The geology of the region includes intermediate to felsic intrusive systems, alkalic and ultramafic complexes, volcanic centers, skarns, greenstone belts, quartz veins in schists, and a variety of clastic and chemical-precipitate sedimentary rocks. Several hundred prospects and areas of mineralization have been identified, many not reported in the public literature. The most clearly identified prospects include vein and disseminated gold and silver, volcanogenic massive sulfides, carbonate- and shale-hosted lead and zinc, porphyry copper, stockwork molybdenum, placer gold and tin, lode tin, tungsten skarns, vein mercury and antimony, sedimentary and hydrothermal uranium, and coal. Further evaluation is necessary to determine the type and economic potential of most prospects.

DOYON holds substantial lands in several well-known historic placer gold districts; including the Iditarod mining district (loc. 36, fig. 49), which has produced over 1.6 million ounces (49,766 kg) of gold, and the Candle Creek (loc. 32, fig. 49), Rampart (loc. 25, fig. 49), Hughes (loc. 27, fig. 49), and Ruby (loc. 28, fig. 49) mining district, which have produced 100,000 to 500,000 ounces (3,100-to-15,500 kg) of gold each.

Silver is the major exploration target in several areas of precious metal mineralization. The most promising areas include intrusive-volcanic complexes in the Kuskokwim Mountains, where disseminated and vein silver prospects grade up to several ounces of silver per ton.

Disseminated and skarn copper and molybdenum mineralization, associated with intermediate to felsic intrusive rocks, have been identified on DOYON lands. East of Grayling (loc. 33, fig. 49), trench sampling, geochemical, and petrologic studies suggest that a stockwork molybdenum deposit is present within 1,000 ft (305 m) of the surface.

Numerous lead and zinc prospects were identified on DOYON land during reconnaissance exploration of the region in the late 1970's. A subsequent decline in base metal prices has delayed further evaluation of most of these prospects. Abundant prospects and anomalies near Medfra (loc. 31, fig. 49), and Step Mountain (loc. 23, fig. 49) suggest the presence of two previously unrecognized districts of possible Mississippi Valley-style mineralization. Carbonate- and shale-hosted mineralization in these areas, confirmed by drilling, contain zinc values of 10-20 percent. Lead and zinc mineralization is also present in other areas of DOYON land; in volcanogenic massive sulfide and intrusive-associated environments.

The Kanuti River region (loc. 26, fig. 49) has potential for at least several million cubic yards of ore-grade placer cassiterite, as demonstrated by test pits and drilling, and at least three other areas of disseminated, felsic-intrusive-hosted tin have been identified. Anomalous tin concentrations grade to several percent in bedrock, with extensive anomalies in surrounding soils and stream gravels. In addition, byproduct cassiterite has been recovered in gold placers at several localities.

Tungsten has been the object of extensive exploration on DOYON land. Prospective sites have been identified for tactite, strata-bound, and stockwork deposits, and several sites have been drilled with favorable results.

Vein occurrences of stibnite and cinnabar are present in the Iditarod area (loc. 36, fig. 49), and both minerals have been recovered as byproducts in several placer gold operations. Several other antimony prospects are present elsewhere in the region. Several areas of felsic intrusives contain anomalous rare-earth minerals, but exploration has only been cursory.

Evidence of uranium mineralization on DOYON land includes vein enrichments, highly anomalous uranium and thorium in soils, and local and regionally anomalous radioactivity in intrusive rocks similar to those that are known to host uranium. No significant exploration for sandstone- or unconformity-type uranium deposits has been conducted, although fluvial basins prospective for sandstone deposits have been identified on DOYON land.

Drilling and regional studies indicate that major coal resources are located on DOYON land. The Tonzona coal field (loc. 34, fig. 49), located along the north flank of the Alaska Range, contains a +100-million-ton reserve; drill-hole intercepts indicate at least 150 ft (46 m) of subbituminous coal. DOYON also has substantial land holdings in other areas of known coal mineralization, such as the Nulato and Eagle fields.

A world-class chrysotile-asbestos district has been defined near Slate Creek (loc. 24, fig. 49) in the Yukon-Tanana Uplands. Three deposits have drill-indicated reserves of 55-million-tons (49.9-million-tonnes) of 6.35 percent asbestos fiber. Additional less thoroughly evaluated deposits are also present in the district.

Preliminary field work indicates that several ultramafic complexes on DOYON lands are favorable

environments for chromite, nickel, gold, and platinum-group metals. These range from unaltered ophiolite complexes to isolated masses of uncertain origin with extensive quartz-carbonate alteration.

Access to interior Alaska and DOYON land is facilitated by an integrated highway-railroad-barge system. Several major highways connect the interior to coastal ports, extending north through the region to the North Slope, and east to the Yukon border. Barge service is available approximately five months of the year along the Yukon, Tanana, and Kuskokwim Rivers, major interior rivers along which much of DOYON land is located. The railroad connects with the road and barge system in Nenana, and continues to a seaport at Seward. In addition, airports are present in villages throughout the region, providing access and logistical support for exploration and development programs.

Additional information on mineral resources on DOYON land is available from Dr. Harold J. Noyes, Chief Geologist, DOYON, LTD., 201 1st Avenue, Fairbanks, Alaska 99701 (phone: 907-452-4755; Fax: 456-4755).

COOK INLET REGION, INC.

COOK INLET REGION, INC (CIRI), owns about 601,360 acres (243,370 hm^2) of fee-simple estate; 21,830 acres (8,835 hm^2) of surface estate; and 516,880 acres (209,181 hm^2) of subsurface estate (fig. 48). The lands contain significant deposits of minerals, coal, and gravel.

Late in 1985, ANACONDA MINERALS COMPANY (ANACONDA) transferred most of their mineral holdings in Alaska to CIRI. The holdings are located throughout the state and include significant prospects for precious metals, tin, and chromium. As part of the Anaconda acquisition, CIRI obtained the largest mineral-exploration data base in Alaska. In 1989, NORTH PACIFIC MINING CORPORATION, a wholly owned subsidiary of CIRI, was formed to facilitate the development of CIRI's mineral potential. Descriptions of several properties are listed below:

Kougarok tin-tantalum prospects (loc. 15, fig. 49): This prospect is located on the Seward Peninsula, 80 miles north of Nome (Puchner, 1986). High-grade tin mineralization in greisenized granite was discovered at Kougarok Mountain in 1979. From 1980 to 1983, exploration on the prospect consisted of detailed mapping, geochemical, and geophysical surveys, 33,000 ft (10,058 m) of drilling, and over 3,000 ft (914 m) of trenching. High-grade tin mineralization at Kougarok occurs in greisenized granitic plugs, dikes, and sills of Cretaceous age that intrude a sequence of pelitic schist and marble. Several million tons of low-grade tin mineralization occurs as veins and stockworks within the schist. A high-grade tin resource of approximately 150,000 tons that grades better than one percent tin has been outlined, and up to 0.1 percent tantalum is found in selected zones.

Kelly Creek prospect (loc. 16, fig. 49): This prospect is located on the Seward Peninsula at Quartz Creek, 45 miles (72 km) northwest of the end of the Nome-Taylor Highway. The prospect consists of three zones of anomalous gold, arsenic, mercury, and antimony associated with graphitic schist and schistose marble. Drilling intersected disseminated-gold mineralization in graphitic schist over widths of 40 to 75 ft (12 to 23 m); average grade is 0.035 oz/ton (1.2 g/tonne) gold. BHP-UTAH INTERNATIONAL performed field work for CIRI at the Kelly Creek prospect. Soil grids were extended and additional sampling points established across the prospect, and within drainages in and around the property. CIRI and BHP-UTAH are finalizing negotiations on an exploration agreement with option to lease at this time.

Illinois Creek mining district (loc. 29, fig. 49): This district includes numerous precious and base metal prospects located in the Kaiyuh Mountains, 60 miles (96 km) southwest of Galena. Mineralization was discovered during a regional reconnaissance program in 1980. Subsequent work included trenching, drilling, regional exploration, and construction of a large camp and airstrip. The two most promising prospects in the district are on Illinois and Waterpump Creeks. On Illinois Creek, trenching and drilling outlined a gossan body 120-ft-wide (37 m) and over 1/2-mile-long (805 m) that contains significant gold in oxidized zones that may be amenable to open-pit mining. Since the discovery of mineralization in this district in 1980 by Anaconda geologists, geologic and assay data has been collected from a total of 4,515 ft (1,376 m) of trenching; 14,000 ft (4,267 m) of diamond drilling, and 11,356 ft (3,461 m) of reverse circulation drilling; including 815 ft (248 m) of trenching and 3,656 ft (1,114 m) of reverse circulation drilling done in 1988. At present, the total reserves of the deposit are estimated at nearly 1.7 million tons (1.5 million tonnes) grading 0.071 oz/ton (2.4 g/tonne) of gold and 2.05 oz/ton (70 g/tonne) of silver. Of this total, the deposit con-

tains approximately 710,000 tons (644,112 tonnes) classified as proven and probable, at a grade of 0.078 oz/ton (2.6 g/tonne) gold and 2.26 oz/ton (77.5 g/tonne) silver. In 1988 an agreement was reached with GOLDMOR GROUP, LTD., of Vancouver, British Columbia, to explore and develop the Illinois Creek property. In 1989, a 5-ton (4.5 tonne) bulk sample was removed from the property for metallurgical testing purposes and determination of amenability to heap leaching. Future plans call for additional trenching and drilling to further delineate the deposit, which remains open along strike to the northeast, and also to the southwest, as well as at depth.

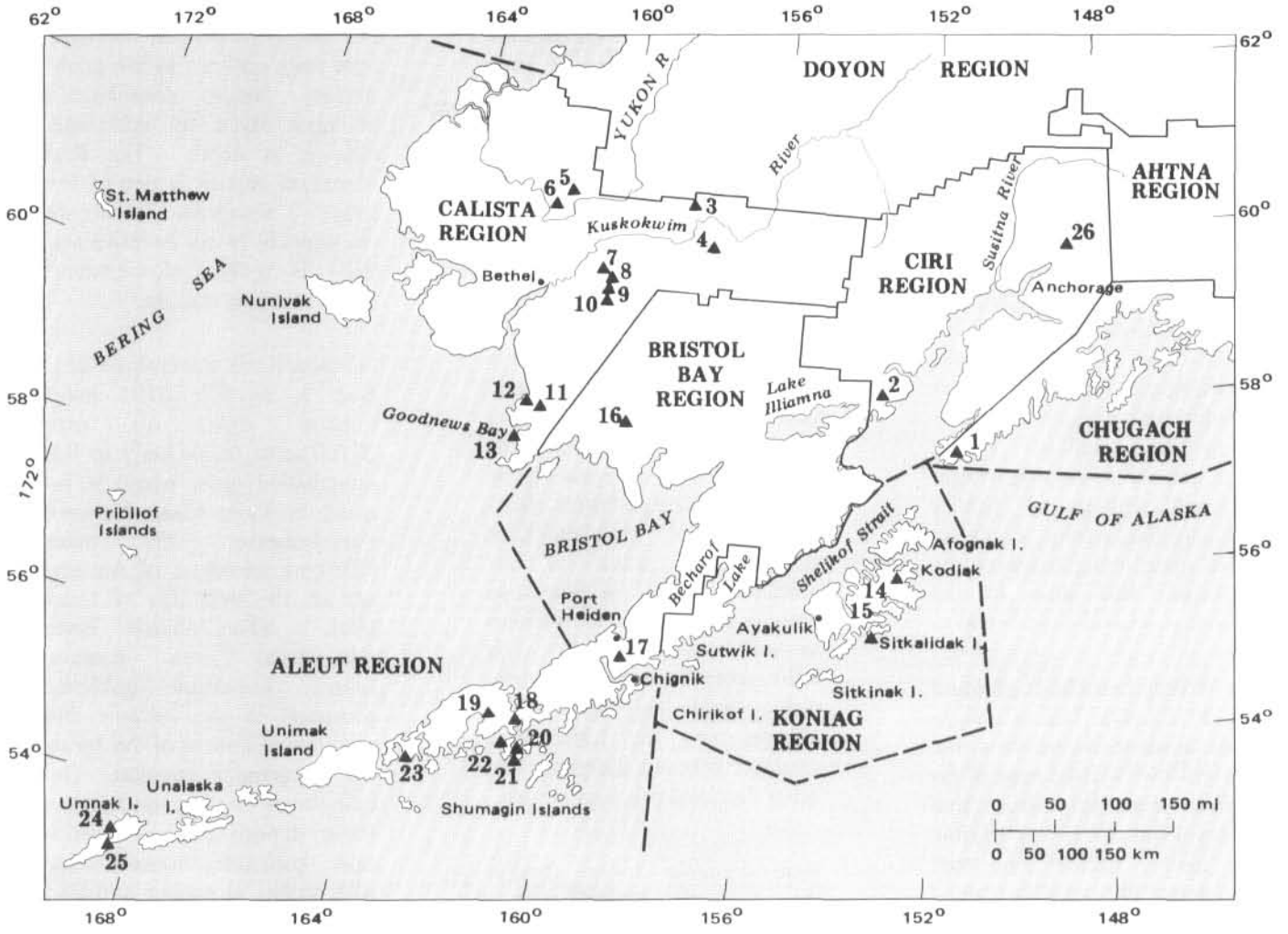
The Waterpump Creek prospect (loc. 30, fig. 49): This is a high-grade silver-lead-zinc prospect. The shallow oxidized zone of the deposit contains silver that grades from 15 to 20 oz/ton. The deeper sulfide zone contains about 20 percent combined lead and zinc with silver credits. At Waterpump Creek, which is included within CIRI's block of contiguous state claims that comprise the Illinois Creek mining district, no additional work has been done to date. Additional drilling is planned in 1990.

Farewell mining district (loc. 35, fig. 49): CIRI holds almost 100,000 acres (40,470 hm^2) in fee-simple estate in this district, and is seeking participants for exploration. Deposits in the mining district are located on the north flank of the Alaska Range, 150 miles (241 km) northwest of Anchorage. Government investigations (Reed and Elliott, 1968) and industry reconnaissance studies in 1980 and 1981 located 15 deposits of polymetallic sulfide mineralization. Only six deposits have been evaluated in detail, and only two have been drilled. At the Dall prospect, black shale hosts structurally controlled massive-sulfide mineralization (1 to 4 percent copper and 411 ppm silver). The mineralized zone varies from 12- to 30-ft-wide (3 to 10 m) and extends to at least 500 ft (152 m) along a strike length of at least 1 mile (1.6 km). At the 6920, Tin Creek, and Little Bird prospects, the mineralization appears to be classic low-temperature, fracture-controlled, lead-zinc-silver skarns that occur as replacement bodies in limestone (Szumigala, 1987). In addition to sulfide mineralization, the 6920 prospect contains appreciable gold that grades to 12 ppm, and the Little Bird prospect contains tungsten and other base and precious metals.

Red Mountain chrome deposit (loc. 1, fig. 50): This deposit is located on the Kenai Peninsula, 140 miles (224 km) south of Anchorage, and is accessible by road from Seldovia. Through the ownership of patented claims and fee-simple title, CIRI controls about 75 percent of the property with the highest mineral potential. Chromite mineralization at Red Mountain is hosted by a layered ultramafic body 4-miles-long (6.4 km) and 2-miles-wide (3.2 km). About 37,000 tons (33,566 tonnes) of high-grade chromite ore was produced intermittently from 1942 to 1976. Based on estimates by the USBM about 100,000 tons (90,720 tonnes) of 28.6 percent chromite ore remain in at least five high-grade zones. More than 20 million tons (18 million tonnes) of open-pit, minable resources that grade 5.6 percent chromite have been outlined in low-grade stringer zones; considerable potential exists for additional tonnage at depth. The Red Mountain deposit is one of the larger low-grade chrome resources in North America and CIRI is seeking development partners in this venture.

Johnson River mineralized area (loc. 2, fig. 50): CIRI holds mineral rights to over 20,000 acres (8,094 hm^2) in this mineralized area, which is located in Lake Clark National Park-Preserve, 130 miles (208 km) southwest of Anchorage on the west side of Cook Inlet. The Johnson River mineralized area contains several important gold-zinc prospects in the volcanic and volcaniclastic rocks of the Jurassic Talkeetna Formation. Detailed work on the main Johnson River deposit outlined significant gold-zinc mineralization with credits of copper and lead in a steep quartz-stockwork zone. Average zinc grades of 9.4 to 24.8 percent zinc, 2.8 percent lead, 1.7 percent copper, and 20 to 36 ppm gold have been reported. CIRI negotiated a Letter of Agreement with HOWARD KECK to conduct further exploration of the deposit, which is being evaluated as a potential underground high-grade gold mine by HUNT, WARE, & PROFFETT.

Manhattan gold-silver-lead-zinc prospect (loc. 17, fig. 50): This prospect is located on the Alaska Peninsula, 30 miles (48 km) south of Port Heiden and 20 miles (32 km) north of Chignik. The prospect consists of multiple steeply dipping sulfide veins that cut a



1. Red Mountain chrome deposit (CIRI)
2. Johnson River gold-zinc deposit (CIRI)
3. *Donlin Creek placer gold deposit* (Calista)
4. Red Devil mercury-antimony area (Calista)
5. Kako Creek and Stuyahok River placer gold deposits (Calista)
6. Arnold lode gold prospect (Calista)
7. Bogus Creek placer gold deposit (Calista)
8. Tuluksak or Nyac placer gold prospect (Calista)
9. Bear placer gold prospect (Calista)
10. Marvel placer gold prospect (Calista)
11. Wattamuse Creek placer gold deposit (Calista)
12. Aerolic River placer gold deposit (Calista)
13. Goodnews Bay placer platinum district (Calista)
14. Chalet Mountain lode tungsten deposit (Koniag)
15. Sitkalidak Island lode copper deposit (Koniag)
16. Kemuk Mtn. platinum-iron deposit (Bristol Bay)
17. Manhattan gold-silver-lead-zinc prospect (CIRI)
18. Pyramid Peak copper-molybdenite deposit (Aleut)
19. Canoe Bay gold prospect (Aleut)
20. Aquilla-Orange Mountain-Shumagin gold-silver prospect (Aleut)
21. *Apollo Sitka gold prospect* (Aleut)
22. Hog silver-gold prospect (Aleut)
23. Walrus Peak gold-silver prospect (Aleut)
24. Kigunak gold-silver prospect (Aleut)
25. Steeple Mountain gold prospect (Aleut)
26. Wishbone Hill coal (CIRI)

Figure 50. *Selected mineral prospects held by Cook Inlet Region Inc., Calista, Koniag Inc., and Aleut Regional Corporations, 1989.*

northeast-trending ridge of andesite porphyry. Surface assays over vein widths of 2 to 4 ft grade 17 ppm gold, 308 ppm silver, and 15 percent lead and zinc. Vein intercepts that contain similar amounts of gold have been drilled to 400 ft (122 m). Additional exploration is required to determine the feasibility of mining.

NERCO EXPLORATION (NERCO) has been involved in on-going research on the metallurgical characteristics of ores found in CIRI and NERCO claims in the Delta area on the north flank of the Alaska Range. The area has significant massive sulfide mineralization rich in lead, zinc, silver, and gold. Additionally, talks are currently continuing with a major worldwide mining company for the exploration and development of some of CIRI's mineral interests on the Seward Peninsula. Recently, CIRI entered into a lease agreement with IDEMITSU ALASKA, INC., the Alaskan subsidiary of the Japanese multinational corporation IDEMITSU KOSAN INC. to mine CIRI coal in the Wishbone Hill area (loc. 26, fig. 50).

Additional information on mineral resources in the CIRI region is available from Mike Franger, Senior Land Management Officer, COOK INLET REGION, INC., 2525 C Street, Suite 500, P.O. Box 93330, Anchorage, Alaska 99509-3330 (phone: 907-274-8638; Fax: 907-279-8836).

CALISTA CORPORATION

CALISTA CORPORATION is actively involved in several mining ventures. The corporation's land entitlement totals about seven million acres (2.8 million hm^2) in southwestern Alaska. The region includes navigable portions of the Kuskokwim and Yukon Rivers. CALISTA has major land holdings in several historic placer gold districts; including portions of the Iditarod district, which produced over three million ounces of gold; the Marshall district, which produced approximately 120,000 ounces (3,732 kg) of gold; the Nyac-Aniak district, which produced over 600,000 ounces (18,662 kg) of gold; and the Goodnews Bay district, where over 575,000 ounces (17,885 kg) of refined platinum-group metals were produced from the Salmon River, and where 30,000 ounces (933 kg) of gold were produced, mostly from the Wattamuse mine. A total of 40 placer gold deposits with recorded production are present in the CALISTA region.

The tectonic setting of the CALISTA region can be summarized as a relatively thin crust with a high regional heat flow and a network of strike-slip faults with major right-lateral and vertical displacement. The faults localize a belt of Late Cretaceous-early Tertiary subalkaline volcano-plutonic complexes which provide the source for precious metal mineralization, including vein and disseminated gold and silver, placer gold, and epithermal mercury and antimony deposits. Platinum placers are derived from a zoned, Alaska-type ultramafic intrusion. Descriptions of some of CALISTA's prospects are listed below:

Donlin Creek (loc. 3, fig. 50): This is an active placer camp with over 30,000 ounces (933 kg) of past production. At the head of the placer deposits a swarm of sericite- and clay-altered rhyolite dikes cutting lithofeldspathic sandstones host a large gold occurrence with associated arsenic, mercury, and antimony anomalies. CALISTA has leased the area to WESTGOLD which has been exploring the area for the last two seasons.

The Red Devil mine area (loc. 4, fig. 50): This includes several lode cinnabar and stibnite occurrences including the Red Devil mine, Alaska's largest producer, which shipped over 35,000 flasks (1.2 million kg) of mercury. Recently, significant gold, silver, and arsenic anomalies have been found adjacent to the hot spring-derived mercury deposits. CALISTA has leased a major portion of the Red Devil area to BHP-UTAH, who have initiated a serious exploration effort in the district.

The Nyac mine area (locs. 7, 8, and 9, fig. 50): This area has produced over 460,000 ounces (14,308 kg) of placer gold. Several mesothermal vein occurrences have been identified within the district, hosted by Paleozoic volcanics and sediments that have been intruded by Cretaceous-Tertiary subalkaline monzonite stocks. CALISTA is currently evaluating some multi-element anomalies which may have large tonnage potential on the periphery of the placer deposits.

The Stuyahok placer deposit (loc. 5, fig. 50): This deposit was examined by CALISTA in 1989. The main deposit lies in the headwaters of the Stuyahok River in an area of subdued relief; significant placer reserves remain to be mined. Lode mineralization appears to be related to a sericite- and clay-altered porphyritic rhyolite underlying the valley floor. Locally, the rhyolite contains anomalous gold, silver, arsenic, mercury, and antimony. Elsewhere in the district, significant lode gold anomalies occur at the head of Willow Creek, and at the Kako gold placer.

With the exception of the original federal placer claims, CALISTA holds the majority of mineral rights in the Goodnews Bay platinum district. CALISTA's holdings include the Red Mountain and Susie Mountain ultramafic complexes which host limited platinum-group metals (PGM) lode anomalies, and PGM placer resources adjacent to the federal placer claims in the Salmon River valley. Additional placer resources are indicated in other drainages in the area.

Limited diamond drilling of the pyroxenites surrounding the dunite core of Red Mountain (loc. 1, fig. 50) identified limited but interesting lode PGM anomalies in serpentinized

contacts. Targets for additional exploration include deeply weathered ultramafic rocks poorly exposed in the placer tailings in the Salmon River valley, broad areas of PGM enrichment, defined by soil sampling, on Susie Mountain (loc. 13, fig. 50), and in the border-phase pyroxenites on the flanks of Red Mountain.

In 1916, placer gold was discovered on Wattamuse Creek and the creek produced over 27,000 ounces (839 kg) of gold. A substantial amount of placer ground remains unmined (loc. 11, fig. 50). A lode source for the placer has been identified at the headwaters of the creek in a quartz vein system hosted in the cupola of a subalkaline monzonite complex. The quartz veins bear arsenopyrite, orpiment, realgar, pyrite, chalcopyrite, and stibnite with gold values to 10 ppm. A detailed soil grid over the vein occurrence averaged 0.31 ppm gold with values as high as 1.4 ppm.

The Ikuk prospect was discovered in 1974 in the upper levels of another monzonite complex. The 800-ft-wide (244 m) mineralized zone exposed in a cirque wall consists of fractured and altered diorite-gabbro cut by aplite dikes. Mineralization consists of chalcopyrite, arsenopyrite, pyrrhotite, and pyrite, with the highest gold values in arsenopyrite-quartz veins. CALISTA sampled the zone in 1989 and obtained gold values up to 24 ppm with average values of 2.3 ppm gold and 4.7 ppm silver. A train of fractured and gossanous material extends several hundred feet down both sides of the saddle, suggesting a potential strike length of several thousand feet.

In addition to the hard-rock mineral properties listed above CALISTA owns significant tracts of the Yukon delta, the Bethel basin (Kuskokwim delta), and a small portion of the Holitna basin. The sedimentary sequence in the Yukon delta and the Bethel basin includes an uncertain thickness of Tertiary sediments overlaying a thick package (15,000 ft or more) of Cretaceous sediments.

CALISTA's lands can be characterized as frontier acreage of low to unknown potential. In the 1960's one hole was drilled into 14,000 ft of over-mature, herbaceous Cretaceous sediments on the edge of Bethel basin. Although some small scale seismic programs were conducted in the 1970's, this single drill hole is the most significant test of a sedimentary basin nearly the size of Oklahoma.

CALISTA CORPORATION is the major supplier of sand, gravel, riprap, and quarried stone for over 50 villages and towns in southwest Alaska. CALISTA leases, manages, and catalogues material sites throughout the region.

CALISTA is interested in entering into mineral leases and participating in joint ventures on oil and gas, lode exploration projects, and small placer operations. CALISTA currently has two exploration leases in effect and is receiving royalties from two placer mines. Goals for the future include an increase in small placer operations and the development of a major hard-rock mine.

Additional information on mineral resources in the CALISTA region is available from Bruce Hickok, Exploration Geologist, Land and Resources Department, CALISTA CORPORATION, 601 W. 5th Avenue, Suite 200, Anchorage, Alaska 99501-2225 (phone: 907-279-5516; Fax: 907-272-5060).

BRISTOL BAY NATIVE CORPORATION

The BRISTOL BAY NATIVE CORPORATION (BBNC) entitlement includes 3.1 million acres (1.25 million hm^2) of land east of the Aleutian Islands and west of Cook Inlet (fig. 50). This area consists of coastal lowlands, volcanic terrain, and broad river valleys. Mountains on the west, north, and northeast are composed primarily of sedimentary rocks, including shale, siltstone, graywacke, and limestone, with minor igneous intrusions. In the early 1980's RESOURCE ASSOCIATES OF ALASKA initiated an exploration program on BBNC lands in southwest Alaska, but many areas in the region have not been explored. Limited mineral exploration has shown that the most prevalent metallic minerals are gold, silver, copper, zinc, lead, molybdenum, tin, tungsten, and iron; the region also has coal resources.

In the western part of the BBNC region there is potential for hot-spring and vein-hosted mercury and stibnite deposits similar to those at Cinnabar Creek. This type of deposit is commonly associated with epithermal mineralized systems containing precious metals. Platinum group metals might be associated with zoned "Alaskan-type" ultramafic plutons such as Kemuk Mountain (loc. 16, fig. 50) in the western part of the region.

A recent discovery of tin near the northcentral boundary of the BBNC region at Sleitat Mountain is indicative of the potential for similar deposits elsewhere in the area. There are a number of epithermal vein deposits containing gold, silver, and copper in the Alaskan Peninsula portion of the region. Some of the alteration zones associated with these veins are of sufficient size to suggest the presence of underlying porphyry systems. Several copper-molybdenum porphyry systems are known near the eastern boundary of the BBNC land entitlement area, and there is potential for copper-gold porphyries such as the Pyramid Peak prospect (loc. 18, fig. 50), or molybdenum-gold-silver porphyry systems such as the nearby Mike prospect.

Additional information on mineral resources in the BBNC region is available from Jack Moores, Land Planning, BRISTOL BAY NATIVE CORPORATION, 800 Cordova Street, Anchorage, Alaska 99501 (phone: 907-278-3602; Fax: 907-276-3924).

KONIAG, INC.

The KONIAG, INC. subsurface entitlement of 1.1 million acres (445,170 hm^2) includes Kodiak Island, Afognak Island, and the eastern Alaska Peninsula between Kujulik Bay and Becharof Lake (figs. 48 and 50). Kodiak Island, particularly the northwestern half, contains gold, silver, copper, lead, zinc, and tungsten deposits. Along the western beaches of the island, placer deposits of gold, magnetite, pyrite, chromite, and platinum have been mined on a small scale in recent decades. A small tungsten lode occurs on Chalet Mountain (loc. 14, fig. 50), 10 miles (16 km) west of Kodiak, and a small copper lode is located on the northwest side of Sitkalidak Island (loc. 15, fig. 50). The presence of chromite and platinum placers suggests that additional lode deposits may be associated with a belt of intrusive rocks located along the northwest coast of Sitkalidak Island. Coal outcrops are located near Ayakulik and on Sitkinak Island, where coal was gathered from the beaches by early explorers.

Additional information on mineral resources in the KONIAG region is available from Frank Pagano, President, KONIAG, INC., 4300 B Street, Anchorage, Alaska 99503 (phone: 907-561-2668; Fax: 907-562-5258).

ALEUT CORPORATION

The ALEUT CORPORATION has rights to about 1.4 million acres (566,580 hm^2) of subsurface estate and 50,000 acres (20,235 hm^2) of fee-simple estate in the lower Alaska Peninsula and Aleutian Islands (fig. 50).

Numerous prospects for gold, silver, coal, porphyry copper, and other base metals have been identified in exploration programs conducted on Aleut lands by KENNECOTT CORPORATION, FREEPORT MINING COMPANY, UNC TETON, RESOURCE ASSOCIATES OF ALASKA, HOUSTON OIL AND MINERALS, and QUINTANA-DUVAL. BATTLE MOUNTAIN EXPLORATION COMPANY has leased some 2,000-$mile^2$ (5,180 km^2) or 1.28 million acres from the ALEUT CORPORATION, and has outlined a possible resource of 5 million tons (4.5 million tonnes) of 0.045 oz/ton (1.5 g/tonne) gold at its Centennial Project south of Sand Point on Popof Island. Descriptions of several prospects are listed below:

Pyramid Peak (loc. 18, fig. 50): A copper-molybdenite monzonite porphyry that intrudes black siltstones of the Cretaceous Hoodoo Formation. Estimated to contain 113 million tons (102.5 million tonnes) of 0.403 percent copper with credits of molybdenite in a smaller but richer chalcocite blanket. It has been drilled for copper; follow-up sampling indicated anomalous gold and silver.

Canoe Bay (loc. 19, fig. 50): A rhyolite porphyry dome intruded into a thick clastic pile. Stockwork development displays anomalous gold, silver, mercury, and arsenic throughout the 1-$mile^2$ (2.6 km^2) project area.

Aquilla-Orange Mountain-Shumagin trend (loc. 20, fig. 50): An epithermal vein and stockwork system that contains the Orange Mountain prospect, a 2.7-$mile^2$ (7 km^2) area of brecciation and intense silica alteration that displays potential for both large-tonnage disseminated-gold deposits and smaller bonanza-type gold-silver vein deposits. Anomalous gold that grades 2.8 ppm, silver that grades 26 ppm, mercury, thallium, tellurium, and bismuth are found in the area; the property has been tested with three drill holes.

Apollo-Sitka trend (loc. 21, fig. 50): An epithermal vein system that may contain extensions of mineralization associated with the Apollo-Sitka mine, which produced 107,900 oz (3,356 kg) of gold from 1892 to 1912 with an average grade of 0.22 oz/ton (7.5 g/tonne).

In 1987, ALASKA APOLLO GOLD MINES, LTD. reported reserves in their nearby Shumagin ore zone of 278,201 tons (252,384 tonnes) of 0.524 oz/ton (18 g/tonne) gold and 2.47 oz/ton (85 g/tonne) silver over an average width of 9.3 ft (2.8 m). Fill in drilling in 1989 reportedly increased the reserves, and the grade increased to 0.765 oz/ton (26 g/tonne) over an average 11.1 ft-width (3.4 m).

Hog prospect (loc. 22, fig. 50): Volcanic breccia-hosted silver-gold mineralization in the ring-fracture zone of the Unga caldera. The prospect area is anomalous in silver that grades 270 ppm, gold that grades 1.4 ppm, arsenic, and mercury; the property has been tested with six drill holes.

Walrus Peak (loc. 23, fig. 50): A shear zone with strong argillic alteration produced by a solfataric system; contains anomalous gold that grades 6.4 ppm, silver that grades to 39 ppm, mercury, and arsenic.

Kigunak (loc. 24, fig. 50): A volcanic-hosted, multiphase granodiorite intrusive with alteration indicative of acidic hydrothermal fluids (kaolinite, sericite, silica, and alunite). Areal extent of gold mineralization is difficult to determine because of ash cover; channel samples average

3.4 ppm gold and 19.2 ppm silver; the property has been tested with five drill holes.

Steeple Mountain (loc. 25, fig. 50): This prospect is similar to the Kigunak prospect with extensive zones of silicification, quartz-stockwork veining, potassium flooding, and detectable gold that ranges from 0.005 to 1.3 ppm.

The Aleutian Islands have good potential for development of geothermal energy, which might be harnessed to assist mineral development or processing.

Additional information on mineral resources in the Aleut region is available from Robert Stanton, Director of Lands and Minerals, ALEUT CORPORATION, 4000 Old Seward Highway, Suite 300, Anchorage, Alaska 99503-6087 (phone: 907-561-4300; Fax: 907-563-4328).

AHTNA, INC.

The AHTNA, INC. subsurface entitlement of 1.7 million acres (687,990 hm^2) includes the Wrangell Mountains, Chugach Mountains, Gulkana upland, Lake Louise plateau, Copper River basin, and parts of the Alaska Range (fig. 51). Most of Alaska's historical copper and lode silver production are from deposits on AHTNA property in the Kennecott mining district (loc. 1, fig. 51). AHTNA is a joint venture partner in the Valdez Creek placer operation (loc. 2, fig. 51) near the Denali Highway (see Development and Production sections). The geology of the AHTNA region is favorable for metallic mineral deposits, including gold, copper, silver, zinc, and strategic minerals. However, federal land withdrawals, particularly in the eastern part of the region, have severely limited the potential for new discoveries.

Possible targets within the AHTNA INC. region include: copper-gold porphyries on the south flank of the Alaska Range from the Upper Chulitna district to the Nabesna district; copper-gold skarns in the Maclaren River area of the Alaska Range; and volcanogenic or exhalative polymetallic and base metal sulphide occurrences in the northern Chugach Mountains, the Talkeetna Mountains, and the south side of the central Alaska Range. Recent work in the vicinity of the Denali mine (loc. 2, fig. 51) indicates possible igneous-hosted lode gold sources for the large placer deposits.

Additional information on mineral resources in the AHTNA region is available from Roy Ewan, President, AHTNA INC., P.O. Box 649, Glennallen, Alaska 99588-0649 (phone: 907-822-3476; Fax: 907-822-3495).

CHUGACH ALASKA CORP.

Land holdings of CHUGACH ALASKA CORP. (CAC), headquartered in Anchorage, are about 900,000 acres (364,230 hm^2) of subsurface, situated along 450 miles (721 km) of the Alaska coast from lower Cook Inlet to Icy Bay, and include the cities of Cordova, Valdez, Seward, and Whittier (fig. 51). The region is rich in minerals and has produced 215 million pounds (97.5 million kg) of copper and 144,000 ounces (4,479 kg) of gold, including 54,000 ounces (1,680 kg) of byproduct gold mined from copper deposits (Moffit and Fellows, 1950).

The Port Valdez and Port Wells areas contain notable lode gold deposits. In the Port Valdez area, mineralization occurs in the uplands on the north side of Valdez Arm and near the Cliff mine (loc. 3, fig. 51). In the Port Wells area, the mineralized zone is a few miles wide at the north end of College Fiord, widening to 30 miles at the south end between Portage Pass and Eaglek Bay. The Granite mine (loc. 5, fig. 51), an area of promising mineral potential, is located at Golden. According to PIONEER RESOURCES, INC., known mines and prospects at Port Wells contain about 300,000 ounces (9,331 kg) of gold in ore that grades 0.65 oz/ton (22 g/tonne).

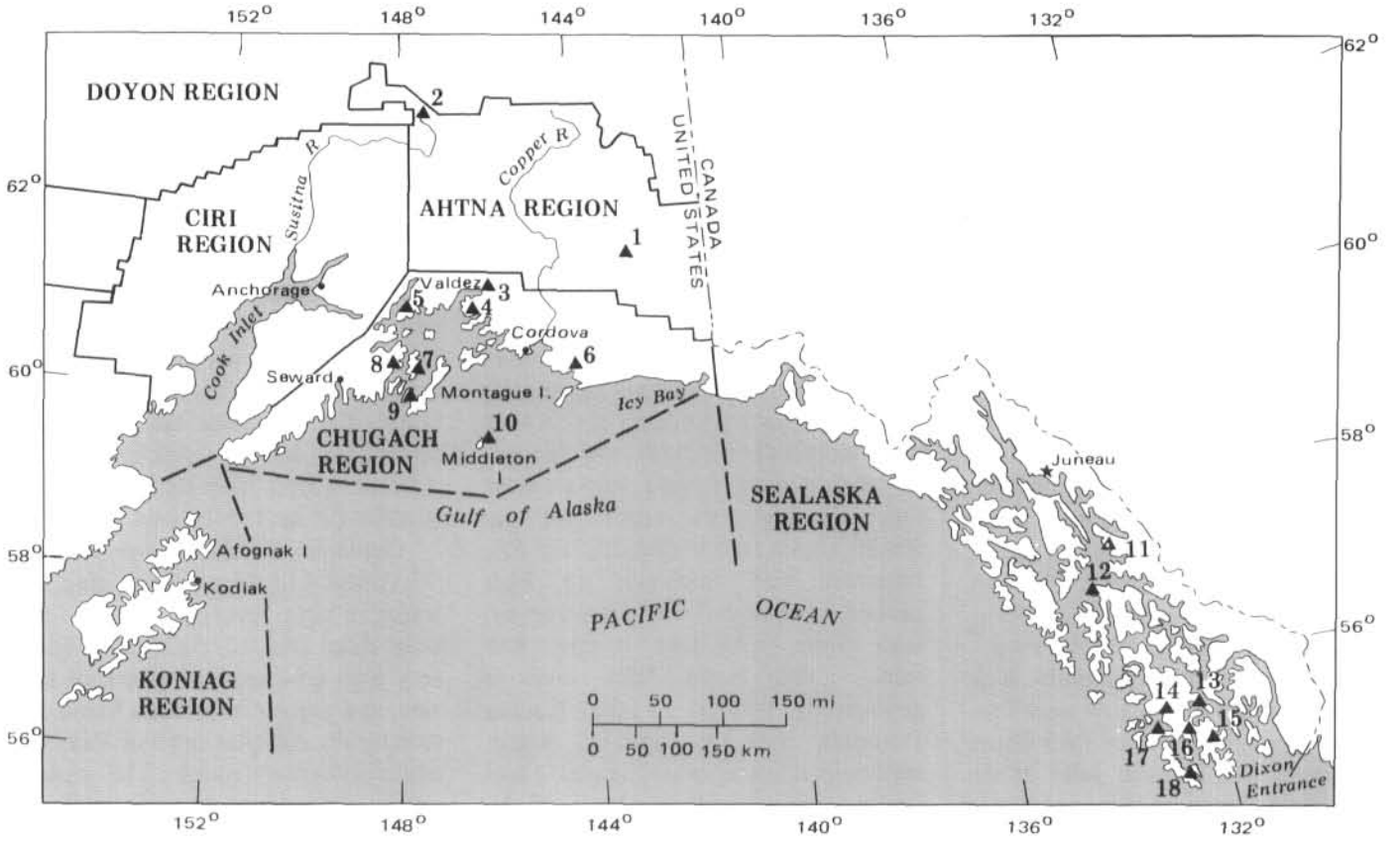
Placer gold deposits are located in beach sands on Middleton Island (loc. 10, fig. 51) and in the dry channel of the Copper River. Other fine-grained, low-grade placer deposits are located in many streams in the King's Bay, Unakwik, Port Wells, Valdez Arm, Copper River, and Lowe River areas. CAC has selection rights to beach placer properties at Cape Yakataga, near those developed by ALASKAGOLD MINES, INC.

Significant copper mineralization is found at Knight Island (loc. 7, fig. 51), LaTouche Island (loc. 9, fig. 51), and at Ellamar (loc. 4, fig. 51), which are owned by CAC. Sedimentary-hosted copper deposits with significant credits of gold have been identified at Ellamar, LaTouche Island, and on the south side of Port Fidalgo. The Beatson mine on LaTouche Island is responsible for 90 percent of the copper produced in the Prince William Sound region.

Manganese is found in low concentrations on Chenega Island (loc. 8, fig. 51), recently investigated by the USBM, and a chrome deposit has been identified in the English Bay and Port Graham area. Cobalt and nickel, which are associated with many of the copper deposits described above, have been identified at Miners River.

CAC owns 73,000 acres (29,543 hm^2) of coal containing an estimated 58 million tons (53 million tonnes) in four formations. Parts of the coal seams are structurally dismembered. The eastern half of the coal field contains mainly anthracite, whereas the western half consists primarily of subbituminous coal. The coals have low ash and moisture contents, and high heating values (from 12,000 to 15,000 Btu).

For additional information on mineral resources in the CAC region, contact Peter Nagel, Lands and Resource Planning, CHUGACH



1. Kennecott mining district lode silver and lode copper deposits (Ahtna)
2. Valdez Creek placer gold deposit (Ahtna)
3. Cliff Mine lode gold deposit (Chugach)
4. Ellamar copper deposit (Chugach)
5. Granite Mine (Chugach)
6. Bering River coal field (Chugach)
7. Knight Island copper deposit (Chugach)
8. Chenega Island manganese deposit (Chugach)
9. LaTouche Island copper deposit (Chugach)
10. Middleton Island placer gold deposit (Chugach)
11. Juneau lode gold deposit (Sealaska)
12. Kake lead-zinc-silver deposit (Sealaska)
13. Kasaan Peninsula copper-iron deposit (Sealaska)
14. Trocadero Bay copper-zinc-silver deposit (Sealaska)
15. Cholmondelay Sound base and precious metal deposit (Sealaska)
16. Jumbo Basin base and precious metal deposit (Sealaska)
17. Black Bear Lake molybdenite-copper and lead-zinc deposits (Sealaska)
18. Dall Island lead-zinc deposit (Sealaska)

Figure 51. *Selected mineral properties held by Ahtna, Chugach Alaska, and Sealaska Regional Corporations, 1989.*

ALASKA CORPORATION 3000 A Street, Suite 400, Anchorage, Alaska 99503-4036 (phone: 907-563-8866; Fax: 907-563-8402).

SEALASKA CORPORATION

The SEALASKA CORPORATION selected lands throughout southeastern Alaska (fig. 51). As of December 1986, 102,700 acres (41,562 hm^2) had been patented and 385,700 acres (156,093 hm^2) had been conveyed by the federal government to the corporation.

SEALASKA partially identified its subsurface resource potential with two reconnaissance exploration surveys that were conducted from 1975 to 1979. The surveys covered about 40 percent of each withdrawal area (except Yakutat) and included literature review, field exploration, geochemical surveys of stream sediments, rock-chip assays, and limited follow-up investigations of mineral anomalies. About 5,000 stream-sediment samples and 500 rock samples were collected and analyzed for mineral values. In addition, SEALASKA catalogued and studied several thousand rock, stream-sediment, and drill-core samples collected by private industry, state, and federal agencies.

SEALASKA recently completed atlases that list resource inventories and land-management programs for their lands. Included in the atlases are descriptions of surface resources,

timber, topography, land-management, and geologically hazardous areas. The subsurface resource inventory lists known minerals and energy occurrences, discusses studies conducted in areas that have available subsurface data, identifies areas that have no subsurface data, and briefly describes geologic investigations that may improve the data base.

Metals with potential for commercial development include: lead, zinc, molybdenum, copper, silver, and gold; a potential exists for development of calcium-rich limestone. Areas of mineral potential include: Prince of Wales withdrawal areas [Hydaburg, Craig, Klawock, Kasaan, and Cholmondelay Sound (loc. 15, fig. 51)]; and Chichagof, Dall, Kuiu, and Admiralty Islands.

Four areas with especially high mineral potential are located near Trocadero Bay, Sunny Hay Mountain, Black Bear, and Shinaku Inlet in the Craig-Klawock area on Prince of Wales Island. The Trocadero Bay area (loc. 14, fig. 51) has moderate to high geochemical values of copper, zinc, silver, and trace amounts of gold. It appears to have a mineralized shear zone in Paleozoic metasedimentary and metavolcanic rocks. In the Black Bear Lake area (loc. 17, fig. 51), mineralized veins contain anomalous concentrations of molybdenum-copper and lead-zinc.

Hydaburg, located on southwestern Prince of Wales Island, contains two large areas of sulfide-mineral potential. Copper, zinc, and silver have been identified in the Soda Bay area, which is composed of Paleozoic metasediments and altered volcanics. Local faulting and shearing appear to be responsible for the structurally complex altered volcanics.

In the Hetta Inlet area, metamorphic rocks of the Precambrian or Paleozoic Wales Group have been intruded by mafic to intermediate igneous rocks of Mesozoic age. Sulfide minerals are found as epigenetic mineralization that consists of veinwork massive sulfides in faults and fissures or contact-metamorphic replacement lodes in bedded rocks, especially in the Jumbo basin area (loc. 16, fig. 51). Minerals with moderate to high economic potential include: copper, lead, silver, gold, zinc, barium, and iron. The Hetta Inlet area is geologically similar to the Kasaan Peninsula (loc. 13, fig. 51), where copper-iron deposits have had commercial production. Most of the 42 million pounds of copper and several hundred thousand ounces of gold and silver produced on Prince of Wales Island came from the Hetta Inlet and Kasaan Peninsula regions. Summaries of the geologic framework of these areas are presented in Herreid and others (1978) and Gehrels and Saleeby (1987).

The Dall Island area (loc. 18, fig. 51), a withdrawal of KLUKWAN VILLAGE CORPORATION, is located on central Dall Island off the southwest corner of Prince of Wales Island. The porphyry and massive-sulfide mineral potential of the area is promising. SEALASKA currently owns about 36,865 acres (14,919 hm^2) of surface and subsurface estate on Dall Island. A geologic reconnaissance of the area by SEALASKA outlined an extensive area with anomalous lead-zinc geochemical values in carbonate and sedimentary rocks of Paleozoic age. Mineralized float and veinwork indicate the presence of Cretaceous to Jurassic porphyritic intrusive rocks. Other than logging roads in east-central Dall Island, access to the island is by air or boat from Ketchikan, about 60 miles (96 km) to the east.

Geologic reconnaissance work by SEALASKA indicates lead, zinc, and traces of silver over an extensive area near Kake (loc. 12, fig. 51). High to very high geochemical values of lead, zinc, and copper have been found in a structurally complex area of Paleozoic metasedimentary rocks. The geologic setting is similar to that of the Greens Creek deposit on northern Admiralty Island.

SEALASKA also has important land positions in the Juneau Gold Belt (loc. 11, fig. 51), Alaska's largest lode gold producing region.

For further information on mineral resources in the SEALASKA region, contact Robert Loescher, Vice President, Resource Management, SEALASKA CORPORATION, One Sealaska Plaza, Suite 400, Juneau, Alaska 99801 (phone: 907-586-1212; Fax: 907-586-9223).

SOVIET-ALASKAN MINERAL, MINING, AND GEOLOGY EXCHANGE PROGRAMS

INTRODUCTION

The warming of relations between the United States and Soviet Union in the Gorbachev era of the late 1980's has stimulated several scientific and cultural exchanges. Additionally, Alaska-based private companies engaged in mining are attempting unique joint venture agreements with Soviet mining industry counterparts.

U.S.A.-U.S.S.R. METALLOGENIC PROJECT

A joint U.S.A.-U.S.S.R. project on comparative metallogenesis of the U.S.S.R. Far East and Alaska was first initiated by the Far East Branch of the Soviet Academy of Sciences (Academy) in 1987. Formal discussions were convened between the U.S. Geological Survey (USGS), and the Academy in 1988 and an agreement was signed late that year. In early 1989 the USGS invited DGGS into the project and field investigations were formally initiated when three Alaskan field geologists spent 5-1/2 weeks visiting mineral districts and mines of the Soviet Far East (fig. 52). The project members are project leader Warren Nokleberg (USGS), Donald Grybeck (USGS),

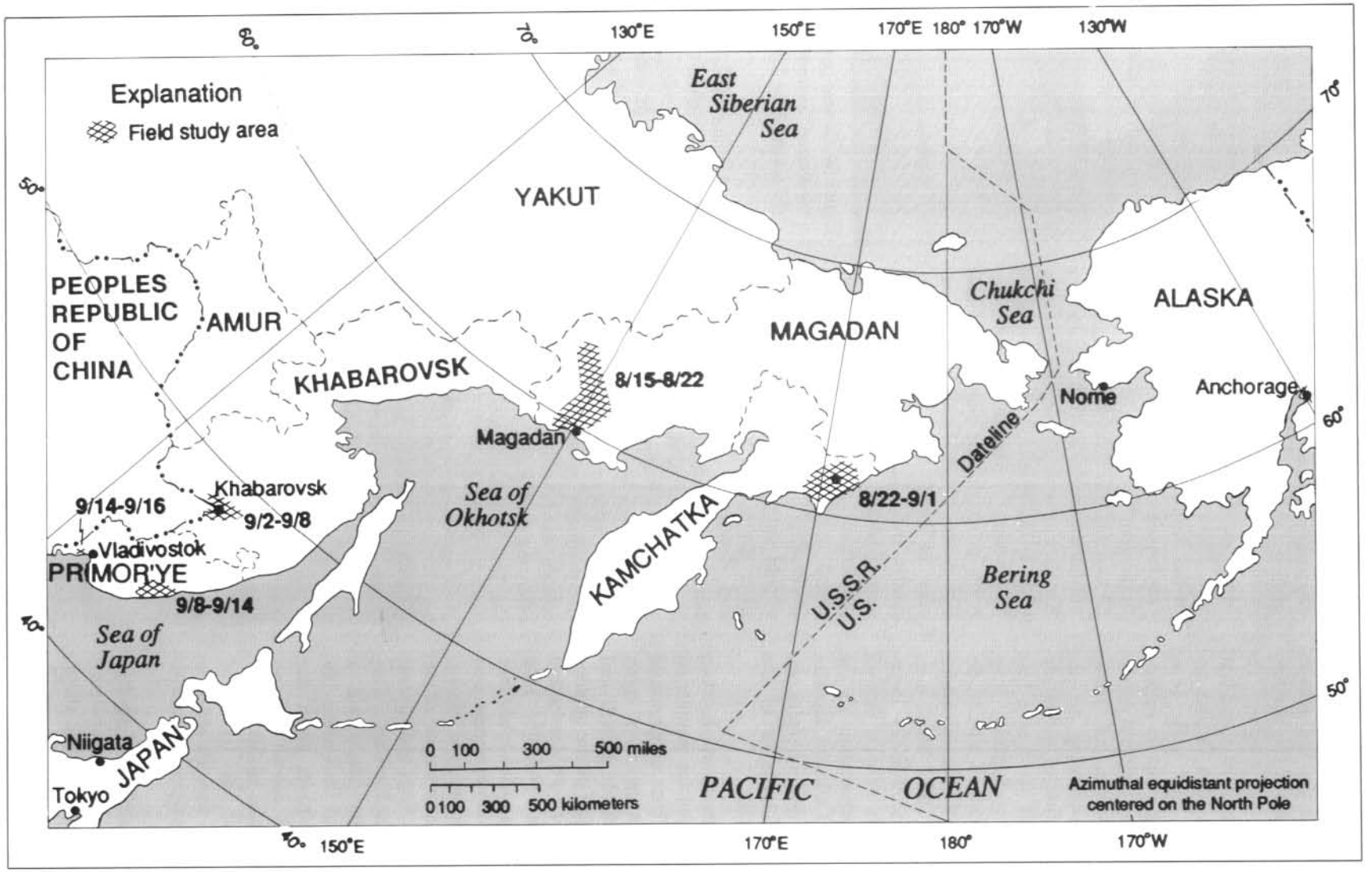


Figure 52. *Areas of investigations by U.S.A.-U.S.S.R. metallogenesis team and U.A.F. mining technology exchanges.*

and Thomas Bundtzen (DGGS). The team will publish maps and professional articles on the mineral deposits and tectonics of the northern U.S.S.R. Far East and Alaska. The metallogenic maps and associated texts will be published in both English and Russian with the map scale being 1:2,500,000. Specific chapters include: (1) formulation of lode mineral deposit models; (2) classification of known mineral deposits according to the models; (3) compilation of a tectonic-magmatic map to be used as a base map for the metallogenic map; (4) plotting of locations of mineral deposits and defining of belts of mineral deposit types on the base map; (5) delineation of geologically favorable tracts for each mineral deposit model; and (6) interpretation of the origin of the belts of mineral deposits. Subsequent articles will interpret the metallogenesis and tectonics of the belts of mineral deposits.

The initial agreement will last two years with projects due for completion in the fall of 1991. The completion of the project and publication of these maps and articles should benefit and increase the knowledge of the geology and metallogenesis of both Alaska and the Soviet Far East. Major lode deposits of copper-zinc-lead-silver sulfides, platinum-group elements, and gold occur on land in western Alaska. Little is presently known outside of the U.S.S.R. about the geology and mineral deposits of the Soviet Far East. This region actually joins Alaska via a submerged continental shelf under the Bering Straits. Learning about the geology and mineral deposits of the Soviet Far East will also enable U.S.A. geologists to project the trends of geology and mineral deposits offshore into the U.S.A. Exclusive Economic Zone.

Geologists and managers of the Far East Branch of the U.S.S.R. Academy of Sciences are greatly enthused about the project. The U.S.A. metallogenesis team was warmly received during the 1989 trip to the Soviet Union. Substantial scientific progress was made. Long and complex scientific discussions were conducted in the offices and laboratories of the Academy of Sciences Institute in Magadan, Khabarovsk, and Vladivostok. Field trip studies were conducted in the Susuman, Karemken, and Ust Omchug camps of the Kolyma district, in the southern Magadan region (figs. 53 and 54), the Koryak Mountains in northern Kamchatka (fig. 55), and the Kavalerovo and Dalnegorst ore districts in the Primoryé region north of Vladivostok. Magadan region currently produces approximately 2.5 million ounces (77,760 kg) gold or 25 percent of total U.S.S.R. production, mostly from placer mines. Studies were made of quartz-vein gold, epithermal gold-silver, tin greisen, zoned mafic-ultramafic plutons with platinum-group metals, placer deposits of gold and platinum, copper-lead-zinc-silver skarn, and boron skarn mines and deposits. The unique "BOR" boron mine complex north of Vladivastok was one of the highlights of the excursions, as it represents perhaps the largest boron production unit in the world. The team went underground in five producing mines. In many of the remote areas visited, the team was often the first group of Americans or the first American geologists to visit the areas since World War II. Almost all geologists in the field, from both the Ministry of Geology and Academy of Sciences, were extremely open with their geologic data, maps, samples, and interpretations. Many rock and ore samples were collected, including gold ores.

Figure 54. *Coarse gold from a dredge operation, Susuman district, U.S.S.R Photograph by T.K. Bundtzen, 1989.*

A complete set of color geologic maps of the Soviet Far East were

Figure 53. *Gold dredge #171 at work near Susuman, Kolyma district, one of 247 dredges that mined metals in the U.S.S.R. during 1989. Photograph by T.K. Bundtzen, 1989.*

obtained that are not readily available elsewhere. Detailed geologic mapping coverage in the Soviet Far East is more advanced than that in Alaska. Detailed 1:50,000 scale mapping covers nearly 85 percent of the Soviet Far East and about 10 percent of Alaska as of 1990. Nearly 100 percent coverage of 1:200,000 scale maps exists in the Soviet Far East.

Team members participated in the 1989 Circum-Pacific Council for Energy and Mineral Resources meeting in Kharbarvosk. Papers were delivered by geoscientists from 20 countries rimming the Pacific on lode and placer metallic resources, rare earth elements, and petroleum resources. The team observed western petroleum firms making plans for joint ventures with the Soviet petroleum industry.

During five weeks of July and August 1990, two Soviet field teams will reciprocate the 1989 field work by visiting Alaskan mineral district. R.A. Eremin and S.G. Byalobzhesky from the Ore Deposits and Tectonics Laboratory of the U.S.S.R. Academy of Sciences in Magadan and I.S. Rozenblum from the Geological Production Association of the Ministry of Geology will comprise the first team.

Dr. V.V. Ratkin, chief metallogenesis expert of the Far East Geological Institute in Vladivostok, Primoye and F.S. Kutyev and L.F. Serkova from the Institute of Volcanology in Petropavlovsk-Kamchatsky, Kamchatka, will comprise the second group. Both groups will participate in a rigorous schedule examining various mineral districts in all regions of the state.

As an outgrowth of the metallogenesis exchange the Alaska Miners Association (AMA), USGS, and DGGS will cosponsor a short symposium on the geology of the Soviet Far East and Alaska at the November 7-9, 1990 AMA annual convention in Anchorage. Ten Soviet geologists and engineers from throughout the Soviet Far East have accepted invitations to attend.

U.A.F.-U.S.S.R. MINE TECHNOLOGY EXCHANGE

The University of Alaska Fairbanks (UAF) was funded by the Alaska Science and Technology Foundation (ASTF) to study the Applicability of Siberian Placer Mining Technology to Alaska (Skudrzyk and others, 1990). The exchange was the outgrowth of an

Figure 55. *Soviet and American geologists in the Koryak Mountains, Kamchatka, U.S.S.R. Photograph by Eugeney Siderov, 1989.*

invitation issued by Soviet Far East mining specialists visiting Alaska. The official invitation was sent by Alexander Evsiovica, director of the All Union Scientific Research Institute of Gold and Rare Metals (VNII-1) in Magadan. The UAF proposal specified that a report illustrated with maps, diagrams, photographs, and observations of mining technology will be published and made available to the Alaska mineral industry by late summer 1990. American participants were Dr. Frank Skudrzyk, project leader, Dan Walsh of UAF, Jim Barker of the USBM in Fairbanks, and Rocky MacDonald of ALSINCO DRILLING, INC. The visit took place from September 1 to September 10, 1989. It included air travel from Nome to Providenya, Anadir, and Magadan; and bus transportation into several placer mining camps in the Kolyma mining district. The group traveled to the Karemken, Orotukan, Yagodnoye, Susuman, Shirokiy, and Burkandya placer camps and several lode mining camps, all north of Magadan. The Americans observed dredge, open cut placer, and underground drift mining, recently implemented water recycling technology, overburden stripping techniques, and reclamation practices (fig. 56).

In May 1990 a similar contingent of four Soviet mine specialists from the VNII-1 organization visited Alaskan placer mines and evaluated current mining technologies employed in Alaska's placer industry. Discussions targeted areas of possible joint ventures with UAF and the Alaska mineral industry.

About 90 percent of gold production in the Magadan region is derived from placer mines and about 70 percent of the total is extracted from open cut strip mines similar to those employed in Alaska. The remainder of production is evenly divided between dredge and drift mines. It is estimated that 45,000 to 80,000 are directly employed in mining in the Magadan region.

BERING STRAITS-NORTH EAST GOLD (SVZAL) JOINT VENTURE

The Soviet Far East gold mining association, SEVEROVOSTOK ZOLOTO ("NORTHEAST GOLD"), BERING STRAITS TRADING COMPANY, and GREATLAND EXPLORATION of Anchorage formed a joint venture to develop mineral deposits and exchange mining technology in Alaska and the Magadan region. The three formed SVZAL with a $2.3 million capitalization in November 1989.

The American venture SVZAL-US will be headquartered in Anchorage and the Soviet SVZAL will be based in Magadan. The primary focus of the joint venture is developing mineral properties in both countries.

The first project undertaken by SVZAL-US is the development of an underground placer gold reserve on Little Eldorado Creek about 12 miles north of Fairbanks. A second project which is still being planned will require western mining technology to develop an unnamed base metal mine in the Magadan region. A third planned effort will develop quarry stone in Magadan for use in the Soviet Far East and export markets.

Figure 56. *Mikhael Naumovich, chief of the Sector of Disturbed Lands of the VNII-1 Institute in Magadan, with an example of reclaimed dredge tailings near Orotukan, Kolyma district, Magadan region, U.S.S.R. Photograph by Jim Barker, U.S. Bureau of Mines, 1989.*

REFERENCES CITED

Barnett, J.C., 1989, The Jualin gold prospect, southeast Alaska: Conference Juneau abstracts of Professional papers, p. 10.

Bottge, R.G., 1987, Availability of land for mineral exploration and development in northcentral Alaska: U.S. Bureau of Mines Special Publication, 35 p.

Bottge, R.G., and Northam, J.J., 1987, Availability of land for mineral exploration and development in southcentral Alaska: U.S. Bureau of Mines Special Publication, 45 p.

Brewer, N.H., 1989, Geology of the Niblack Anchorage. Massive sulfide property, Prince of Wales Island, Alaska: Conference Juneau Abstracts of Professional Papers, p. 34-35.

Bundtzen, T.K., 1978, The Richardson lineament--a structural control for gold deposits in the Richardson mining district, interior Alaska: Alaska Division of Geological and Geophysical Surveys Geologic Report 55, p. 29-34.

Bundtzen, T.K., Eakins, G.R., and Conwell, C.N., 1982, Review of Alaska's mineral resources: Alaska Office of Mineral Development Report, 52 p.

Bundtzen, T.K., Eakins, G.R., Clough, J.G., Lueck, L.L., Green, C.B., Robinson, M.S., and Coleman, D.A., 1984, Alaska's mineral industry 1983: Alaska Division of Geological and Geophysical Surveys Special Report 33, p. 4-19.

Bundtzen, T.K., Eakins, G.R., Green, C.B., and Lueck, L.L., 1986, Alaska's mineral industry 1985: Alaska Division of Geological and Geophysical Surveys Special Report 39, p. 3-19.

Bundtzen, T.K., Green, C.B., Deagen, James, and Daniels, C.L., 1987, Alaska's mineral industry 1986, Alaska Division of Geological and Geophysical Surveys Special Report 40, p. 3-20.

Bundtzen, T.K., Green, C.B., Peterson, R.J., and Seward, A.F., 1988, Alaska's mineral industry 1987: Alaska Division of Geological and Geophysical Surveys Special Report 41, p. 4-21.

Bundtzen, T.K., and Swainbank, R.C., 1990, Alaska mineral industry 1989: Division of Geological and Geophysical Surveys Public-data File Report 90-10, 5 p.

Crafford, T.C., 1989, The Greens Creek Ag-Au-Pb-Zn massive sulfide deposit, Admiralty Island, southeast Alaska: Conference Juneau Abstracts of Professional Papers, p. 27-29.

Chapman, R.M., and Foster, R.L., 1969, Lode mines and prospects in the Fairbanks district, Alaska: U.S. Geological Survey Professional Paper 625-D, 25 p.

Eakins, G.R., Bundtzen, T.K., Robinson, M.S., Clough, J.G., Green, C.B., Clautice, K.H., and Albanese, M.A., 1983, Alaska's mineral industry 1982: Alaska Division of Geological and Geophysical Surveys Special Report 31, p. 3-15.

Eakins, G.R., Bundtzen, T.K., Lueck, L.L., Green, C.B., Gallagher, J.L., and Robinson, M.S., 1985, Alaska mineral industry 1984: Alaska Division of Geological and Geophysical Surveys Special Report 38, p. 5-20.

Erickson, J.W., 1989, Employee safety incentive program for the mining industry: Valdez Creek Mining Company unpublished report, 22 p.

Forbes, R.B., 1982, Bedrock geology and petrology of the Fairbanks mining district, Alaska: Alaska Open-file Report 169, 69 p.

Fredericksen, R.S., and Miller, L.D., 1989, Geology and mineralization of the Alaska-Juneau deposit, southeast Alaska: Conference Juneau Abstracts of Professional Papers, p. 11-13.

Gehrels, G.E., and Saleeby, J.B., 1987, Geology of southern Prince of Wales Island, southeastern Alaska: Geological Society of America Bulletin, v. 78, no. 2, p. 123-137.

Gillerman, V.S., 1988, Comment and reply on 'Earthquake rupturing as a mineralizing agent in hydrothermal systems,' Geology, v. 16, no. 7, p. 669-670.

Green, C.B., ed., 1990a, Summary: Usibelli Coal Beneficiation Project: Usibelli Coal Mine Information Brochure #1, 6 p.

____1990b, Healy Cogeneration Project: Usibelli Coal Mine Information Brochure #2, 4 p.

Green, C.B., Bundtzen, T.K., Peterson, R.J., Seward, A.F., Deagen, J.R., and Burton, J.E., 1989, Alaska's mineral industry 1988: Alaska Division of Geological and Geophysical Surveys Special Report 43, p. 79.

Herreid, Gordon, Bundtzen, T.K., and Turner, D.L., 1978, Geology and geochemistry of the Craig A-2 Quadrangle and vicinity, Prince of Wales Island, southeastern Alaska: Alaska Division of Geological and Geophysical Surveys Geologic Report 48, 48 p., scale 1:40,000, 1 sheet.

Hill, J.M., 1933, Lode deposits of the Fairbanks mining district, Alaska: U.S. Geological Survey Bulletin 849B, p. 29-163.

Hughes, Richard, 1990, The Denali placer mine: The Alaska Miner, v. 17, no. 10, p. 14-15, 19.

Jackson, L.P., 1990, Reclamation challenges at Usibelli Coal Mine, Healy, Alaska *in* Bundtzen, T.K., Proceedings of the 11th Annual Conference on Placer Mining, Polar Run Printing, p. 19-22.

Kirkhan, Richard, 1989, Exploration of the Kensington vein system, southeast Alaska: Conference Juneau Abstracts of Professional Papers, p. 9-10.

Martin, Paul, 1990, Update of the Valdez Creek mine project, reclamation and general operations *in* Bundtzen, T.K., ed., Proceedings of the 11th Annual Conference on Placer Mining, Polar Run Printing, Fairbanks, Alaska, p. 11-15.

Merritt, R.D., and Hawley, C.C., 1986, Map of Alaska's coal resources: Alaska Division of Geological and Geophysical Surveys Special Report 37, scale 1:2,500,000, 1 sheet with text.

Moffit, F.H., and Fellows, R.E., 1950, Copper deposits of the Prince William Sound district, Alaska: U.S. Geological Survey Bulletin 963-B, p. 47-49.

Morison, S.R., 1990, Regional placer deposit settings in Yukon Territory, Canada, *in* Bundtzen, T.K., ed., Proceedings of the 11th Annual Conference on Placer Mining, Polar Run Printing, Fairbanks, Alaska, p. 76-77.

Newberry, R.J., and Brew, D.A., 1988, Alteration zoning and the origin of the Alaska-Juneau gold deposit: *in* Galloway, J.P., and Hamilton, T.D., 1988, Geological studies in Alaska by the U.S. Geological Survey: U.S. Geological Circular 1016, p. 174-179.

Newberry, R.J., Burns, L.E., and Solie, D.N., 1990, Gold favorability in the Eagle Quadrangle, Alaska, as predicted by discriminant analysis for non-porphyry granitic rocks: Alaska Division of Geological and Geophysical Surveys Public-data File Report 90-16, 17 p., scale 1:250,000, 1 sheet.

Nokleberg, W.J., Bundtzen, T.K., Berg, H.C., Brew, D.A., Grybeck, Donald, Robinson, M.S., Smith, T.E., and Yeend, Warren, 1987, Significant metalliferous lode deposits and placer districts of Alaska: U.S. Geological Survey 1786, 104 p.

Peterson, L.A., 1990, 1989 annual mining report: Alaska Department of Environmental Conservation special report, 35 p.

Reed, B.L., and Elliott, R.L., 1968, Lead, zinc, and silver deposits at Bowser Creek, McGrath A-2 Quadrangle, Alaska: U.S. Geological Survey Circular 559, 17 p.

Roberts, W.S., 1985, Availability of land for mineral exploration and development in southeast Alaska: U.S. Bureau of Mines special publication, 34 p.

Rusanowski, P.C., 1990, Nome offshore placer project; issues and answers--a 3 year perspective: *in* Bundtzen, T.K., ed., Proceedings of the 11th Annual Conference on Placer Mining, Polar Run Printing, Fairbanks, Alaska, p. 4-10.

Skudryzk, F.J., 1989, Applicability of Siberian placer mining technology to Alaska, Alaska Science and Technology Foundation Grant Report #1, 41 p.

Solie, D.N., Burns, L.E., and Newberry, R.J., 1990, Gold favorability in the Big Delta Quadrangle, Alaska, as predicted by discriminant analysis for nonporphyry granitic rocks: Alaska Division of Geological and Geophysical Surveys Public-data File Report 90-13, 15 p.

Staff, 1972, Annual report 1971: Alaska Division of Geological and Geophysical Surveys annual report, p. 67-71.

_____1974, Annual report 1973: Alaska Division of Geological and Geophysical Surveys annual report, p. 39-42.

_____1976, Biennial report 1974-75: Alaska Division of Geological and Geophysical Surveys biennial report, p. 25-28.

_____1990, 1989 exploration and mining activity: Exploration and Geological Services Division, Department of Indian Affairs and Northern Development, Yukon Territory, Canada, 16 p.

Szumigala, D.J., 1987, Geology of the Tin Creek zinc-lead skarn deposits, McGrath B-2 Quadrangle, Alaska: Alaska Division of Geological and Geophysical Surveys Report of Investigations 87-5.

Williams, J.A., 1960, Report of the Division of Mines and Minerals for the year 1959: Alaska Department of Natural Resources annual report, p. 21-24.

_____1961, Division of Mines and Minerals report for the year 1961: Alaska Division of Mines and Minerals annual report, p. 26.45.

_____1965, Division of Mines and Minerals report for the year 1964: Alaska Division of Mines and Minerals annual report, p. 12-15.

_____1966, Division of Mines and Minerals report for the year 1965: Alaska Division of Mines and Minerals annual report, p. 11-16.

_____1968, Division of Mines and Minerals report for the year 1967: Alaska Division of Mines and Minerals annual report, p. 11-15.

_____1969, Division of Mines and Geology report for the year 1968: Alaska Division of Mines and Geology annual report, p. 8-15.

_____1971, Division of Geological Survey report for the year 1970: Alaska Division of Geological Survey annual report, p. 4-1, 4-5.

APPENDIX A

Total active claims and new claims staked in 1987, 1988, and 1989[a] (listed by quadrangle)[b]

		Active claims assessment work			New claims staked						Total active claims		
					Federal			State					
	Quadrangle	1987	1988	1989	1987	1988	1989	1987	1988	1989	1987	1988	1989
13	Umiat	0	0	0	0	0	0	0	0	0	0	0	0
14	Sagavanirktok	0	0	0	1	1	0	0	0	0	1	1	0
15	Mt. Michelson	0	0	0	0	0	0	0	0	0	0	0	0
17	Point Hope	0	0	0	0	0	0	0	0	0	0	0	0
18	De Long Mts.	2,104	1,809	1,350	0	0	0	0	0	107	2,104	1,809	1,457
23	Phillip Smith Mts.	13	13	9	12	5	2	3	0	1	28	18	12
26	Noatak	532	184	187	0	0	0	0	0	0	532	184	187
27	Baird Mts.	225	299	130	0	0	0	0	0	0	225	299	130
28	Ambler River	294	110	104	0	0	0	0	0	0	294	110	104
29	Survey Pass	94	34	37	0	0	0	0	0	0	94	34	37
30	Wiseman	1,468	1,767	1,393	17	6	3	66	143	90	1,551	1,916	1,486
31	Chandalar	899	945	828	3	12	0	62	28	8	964	985	836
32	Christian	1	1	2	0	0	0	0	0	0	0	1	2
35	Kotzebue	0	16	0	0	16	0	0	0	0	0	16	0
36	Selawik	0	0	0	0	0	0	0	0	0	0	0	0
37	Shungnak	59	51	6	0	0	0	0	0	0	59	51	6
38	Hughes	54	54	54	0	0	0	0	0	0	54	54	54
39	Bettles	508	422	366	17	30	48	27	1	0	552	453	414
43	Teller	1,312	383	380	0	0	0	0	145	98	1,312	528	478
44	Bendeleben	1,302	1,138	1,107	5	9	2	48	158	249	1,353	1,305	1,358
45	Candle	449	463	453	14	8	0	24	9	16	487	480	469
47	Melozitna	76	134	131	32	6	0	19	0	9	127	140	140
48	Tanana	1,461	1,596	1,296	0	1	0	175	19	123	1,636	1,616	1,419
49	Livengood	3,596	3,290	3,578	0	0	0	301	428	328	3,897	3,718	3,906
50	Circle	3,600	3,944	6,940	2	0	0	606	1,397	446	4,208	5,341	7,386
51	Charley River	193	183	146	0	0	0	0	0	18	193	183	164
52	Nome	518	293	687	0	5	0	17	344	103	535	637	790
53	Solomon	200	881	329	0	24	0	64	40	256	264	945	585
54	Norton Bay	0	110	91	0	0	0	0	0	0	0	110	91
55	Nulato	3,500	3,178	3,175	14	10	0	0	0	78	3,514	3,188	3,253
56	Ruby	1,107	974	1,057	0	0	0	4	304	52	1,111	1,278	1,109
57	Kantishna River	287	275	244	1	0	1	0	0	0	288	275	245
58	Fairbanks	2,699	2,505	2,209	0	0	0	346	419	303	3,045	2,924	2,512
59	Big Delta	1,146	1,841	1,839	31	0	0	408	786	105	1,585	2,627	1,944
60	Eagle	2,357	2,256	2,480	0	118	0	60	558	113	2,417	2,932	2,593
63	Unalakleet	0	0	0	0	0	0	0	0	0	0	0	0
64	Ophir	500	474	654	9	0	0	13	192	36	522	666	690
65	Medfra	539	293	250	1	0	0	48	0	9	588	293	259
66	Mt. McKinley	174	319	313	0	0	0	0	0	0	174	319	313
67	Healy	3,249	3,289	3,301	256	736	135	185	172	187	3,690	4,197	3,623
68	Mt. Hayes	4,196	4,682	3,273	249	56	41	95	247	188	4,486	4,985	3,502
69	Tanacross	486	1,150	1,185	18	0	0	193	165	79	697	1,315	1,264
72	Holy Cross	14	9	0	0	0	0	0	0	0	14	9	0
73	Iditarod	514	620	1,586	1	646	54	152	437	63	667	1,703	1,703
74	McGrath	167	325	348	0	0	0	0	238	0	167	563	348
75	Talkeetna	2,179	1,884	2,197	0	5	0	51	181	141	2,230	2,070	2,338
76	Talkeetna Mts.	1,600	1,907	1,528	0	16	0	127	122	177	1,727	2,045	1,705
77	Gulkana	19	19	24	0	0	0	13	21	2	32	40	26
78	Nabesna	280	246	189	0	0	0	0	0	71	280	246	260

	Quadrangle	Active claims assessment work			New claims staked						Total active claims		
					Federal			State					
		1987	1988	1989	1987	1988	1989	1987	1988	1989	1987	1988	1989
81	Russian Mission	2	58	48	0	5	0	0	0	0	2	63	48
82	Sleetmute	332	231	267	0	40	0	33	45	0	365	316	267
83	Lime Hills	135	28	122	0	0	0	16	0	0	151	28	122
84	Tyonek	5,177	4,632	5,340	0	0	0	53	63	11	5,230	4,695	5,351
85	Anchorage	1,135	906	407	3	9	2	115	71	89	1,253	986	498
86	Valdez	299	305	414	8	102	145	293	8	20	600	321	579
87	McCarthy	66	205	186	0	0	0	0	0	0	66	205	186
91	Bethel	66	454	485	0	24	0	4	37	48	70	515	533
92	Taylor Mts.	386	204	273	0	0	0	9	168	12	395	372	285
93	Lake Clark	318	395	588	0	0	0	0	150	10	318	495	598
94	Kenai	5	12	12	0	0	0	5	5	0	10	17	12
95	Seward	1,261	2,340	2,024	557	379	131	95	30	20	1,913	2,749	2,175
96	Cordova	15	15	0	0	0	1	0	0	0	15	15	1
97	Bering Glacier	604	310	283	0	0	0	300	0	0	904	310	283
101	Goodnews	6	2	39	0	0	0	0	39	0	6	41	39
102	Dillingham	18	7	0	0	0	0	0	0	0	18	7	0
103	Iliamna	86	572	700	0	0	0	0	720	133	86	1,292	833
104	Seldovia	87	13	9	0	0	0	0	0	0	87	13	9
105	Blying Sound	2	1	1	0	0	0	0	0	0	2	1	1
107	Icy Bay	11	6	4	0	14	0	0	0	0	11	20	4
108	Yakutat	1	1	1	0	0	0	0	0	2	1	1	3
109	Skagway	209	511	485	5	0	2	4	0	19	218	511	506
111	Mt. Fairweather	6	2	4	0	18	0	1	0	0	7	20	4
112	Juneau	2,173	3,428	3,251	1,213	890	293	38	62	49	3,424	4,380	3,593
113	Taku River	0	0	0	0	0	0	0	0	0	0	0	0
114	Sitka	785	644	432	20	9	0	0	11	0	805	664	432
115	Sumdum	45	147	143	54	14	19	0	0	0	99	161	162
116	Port Alexander	0	184	184	0	0	1	0	0	0	0	184	185
117	Petersburg	1,497	789	480	129	109	23	0	5	0	1,616	903	503
118	Bradfield Canal	8	122	107	240	35	362	0	0	0	248	157	469
119	Craig	502	780	905	182	337	262	0	57	0	684	1,174	1,167
120	Ketchikan	261	367	391	148	34	137	0	0	1	409	401	529
121	Dixon Entrance	333	184	181	22	74	0	0	0	0	355	258	181
122	Prince Rupert	8	9	0	1	0	0	0	0	0	9	9	0
123	Hagemeister Island	0	505	374	0	0	0	0	36	0	0	541	374
126	Mt. Katmai	0	0	0	0	0	0	0	0	0	0	0	0
127	Afognak	3	2	2	0	0	0	0	0	0	3	2	2
130	Karluk	0	0	0	0	0	0	0	0	0	0	0	0
133	Chignik	51	71	71	0	0	0	0	0	0	51	71	71
135	Trinity Islands	158	895	437	0	0	0	982	1	49	1,140	896	486
138	Port Moller	51	38	17	0	0	0	0	0	9	51	38	26
	TOTAL	60,072	63,694	64,123	3,274	3,786	1,664	5,002	8,062	3,928	68,348	75,542	69,715

[a]Total count based on all documents recorded through January 1, 1990.

[b]Quadrangles numbered northwest to southeast according to DGGS-DOM numbering and Kardex systems.

APPENDIX B
State, federal, and private agencies involved in mineral development activities, 1989

STATE OF ALASKA AGENCIES

DEPARTMENT OF COMMERCE AND ECONOMIC DEVELOPMENT
State Office Building, 9th Fl.
P.O. Box D (mailing)
Juneau, AK 99811
(907) 465-2500
Commissioner - Larry Merculieff

Function: Promotes economic development in Alaska.

Division of Business Development
State Office Building, 9th Fl.
P.O. Box D (mailing)
Juneau, AK 99811
(907) 465-2094
Director - Jamie Parsons
Deputy Director - Tom Lawson
Development Specialist - Jim Deagen

1001 Noble St., Ste. 360
Fairbanks, AK 99701
(907) 452-7464
Development Specialist - Richard Swainbank

Function: Primary advocacy agency in state government for economic growth. Researches and publishes economic data on Alaska's mining industry, and provides information and assistance to new or developing businesses.

DEPARTMENT OF ENVIRONMENTAL CONSERVATION
3220 Hospital Dr.
P.O. Box O (mailing)
Juneau, AK 99811-1800
(907) 465-2600
Public Information (907) 465-2606
Commissioner - Dennis D. Kelso

Function: Issues permits for activities, including mining, that affect air or water quality or involve land disposal of wastes. Sets air- and water-quality standards. Inspects, monitors, and enforces environmental quality statutes, regulations, and permits. Reviews all federal permits.

Northern Regional Office
1001 Noble St., Ste. 350
Fairbanks, AK 99701
(907) 452-1714
Regional Supervisor - William McGee

Southcentral Regional Office
3601 C St., Ste. 1350, Frontier Bldg.
Anchorage, AK 99503
(907) 563-6529
Permit Information (907) 563-6529 (collect calls accepted)
Regional Supervisor - Bill Lamoreaux

Nome District Office
P.O. Box 1815
Nome, AK 99762
(907) 443-2600
District Manager - Simon Mawson

Southeastern Regional Office
9000 Old Glacier Hwy.
P.O. Box 32420 (mailing)
Juneau, AK 99803
(907) 789-3151
Permit Information (907) 465-2615 (collect calls accepted)
Regional Supervisor - Dick Stokes

DEPARTMENT OF FISH AND GAME
Capital Office Park
P.O. Box 3-2000 (mailing)
Juneau, AK 99802
(907) 465-4100

Commissioner - Don W. Collinsworth
(907) 465-4100
Director, Habitat Division - Frank Rue
(907) 465-4105

Function: Protects habitat in fish streams and manages refuges, sanctuaries, and critical habitats. Requires permits for any work involving the blockage of fish passage; equipment crossings or operation in streams with anadromous fish; use, diversion, or pollution of streams containing anadromous fish; construction, exploration, or development work in state game refuges, game sanctuaries, and critical habitat areas.

Central Regional Office
Habitat Division
1300 College Rd.
Fairbanks, AK 99701
(907) 451-6192
Regional Supervisor - Alvin Ott

Southcentral Regional Office
Habitat Division
333 Raspberry Rd.
Anchorage, AK 99518-1599
(907) 267-2283
Regional Supervisor - Lance Trasky

Southeastern Regional Office
Habitat Division
803 3rd St., 1st Fl.
P.O. Box 20 (mailing)
Douglas, AK 99824
(907) 465-4290
Regional Supervisor - Rick Reed

OFFICE OF MANAGEMENT AND BUDGET
Division of Governmental Coordination
431 North Franklin St.
P.O. Box AW (mailing)
Juneau, AK 99811-0165
(907) 465-3562
Director - Robert L. Grogan

Function: Conducts coordinated state review of permits for mining projects within Alaska's Coastal Management Zone. Provides information to applicants on project design for consistency with the policies and standards of the Alaska Coastal Management Program. Coordinates state response to direct federal actions, including proposed regulations, that affect Alaska's mining industry.

Northern Regional Office
675 Seventh Ave.
Station H (mailing)
Fairbanks, AK 99701-4596
(907) 451-2818
Project Coordinators - Elizabeth Benson, Patti Wightman

Southcentral Regional Office
3601 C St., Ste. 370, Frontier Bldg.
Anchorage, AK 99503-5930
(907) 561-6131
Project Coordinator - Patty Bielawski

Southeastern Regional Office
431 North Franklin St.
P.O. Box AW (mailing)
Juneau, AK 99811-0165
(907) 465-3562
Project Coordinators - Gabrielle LaRoche, Lorraine Marshall

DEPARTMENT OF NATURAL RESOURCES
400 Willoughby Ave., 5th Fl.
Juneau, AK 99801
(907) 465-2400
Commissioner - Lennie Gorsuch
Deputy Commissioner - Rod Swope
Assistant Commissioner - Tom Hawkins

Function: Principal state agency that administers Alaska's state lands.

Division of Forestry
400 Willoughby Ave., 5th Fl.
Juneau, AK 99801
(907) 465-2491

Function: Establishes guidelines to manage mining in state forests.

Northern Regional Office
3700 Airport Way
Fairbanks, AK 99709
(907) 479-2243
Regional Forester - Lester Fortune

Southcentral Regional Office
3601 C St., Ste. 1058
Frontier Bldg., 10th Fl.
P.O. Box 107005 (mailing)
Anchorage, AK 99510-7005
(907) 762-2501
Director - Malcolm R. Dick
Regional Forester - Dave Wallingford

Southeastern Regional Office
400 Willoughby Ave., 5th Fl.
Juneau, AK 99801
(907) 465-2491
Regional Forester - Jim McAllister

Division of Geological and Geophysical Surveys
3700 Airport Way
Fairbanks, AK 99709
(907) 451-2760
Director and State Geologist - Robert B. Forbes
Deputy State Geologist - Thomas E. Smith

Function: Conducts geological and geophysical surveys to determine the potential of Alaskan land for production of metals, minerals, fuels, and geothermal resources; the locations and supplies of ground water and construction materials; the potential geologic hazards to buildings, roads, bridges, and other installations and structures; and other surveys and investigations as will advance knowledge of the geology of Alaska and general geologic inventories. Publishes a variety of reports that contain the results of these investigations. Advises the public and government agencies on geologic issues. Maintains a library of geologic bulletins, reports, and periodicals and a drill-core storage facility at Eagle River.

Eagle River Office
18225 Fish Hatchery Rd.
P.O. Box 772116 (mailing)
Eagle River, AK 99577
(907) 696-0070
Section Chief - William Long
Juneau Office
400 Willoughby Ave., 3rd Fl.
Juneau, AK 99801
(907) 465-2533
Geologist - Roman J. Motyka

Division of Land and Water Management
3601 C St., Ste. 814, Frontier Bldg.
P.O. Box 107005 (mailing)
Anchorage, AK 99510-7005
(907) 762-2692
Director - Gary Gustafson

Function: Manages surface estate and resources, including materials (gravel, sand, and rock) and water. Handles statewide and regional land-use planning. Issues water-appropriation permits and certificates, leases, material-sale contracts, mill-site permits, land-use permits, and easements for temporary use of state land and access roads. Responsible for safety of all dams in Alaska.

Northern Regional Office
3700 Airport Way
Fairbanks, AK 99709
(907) 451-2757
Regional Manager - Dean Brown

Southcentral Regional Office
3601 C St., Ste. 1080, Frontier Bldg.
P.O. Box 107005 (mailing)
Anchorage, AK 99510-7005
(907) 762-2251
Regional Manager - Veronica Gilbert

Southeastern Regional Office
400 Willoughby Ave., Ste. 400
Juneau, AK 99801
(907) 465-3400
Regional Manager - Andrew Pekovich

Division of Mining
3601 C St., Ste. 800, Frontier Bldg.
P.O. Box 107016 (mailing)
Anchorage, AK 99510-7016
(907) 762-2163
Director - Gerald L. Gallagher
Mining Information - Bob Stuvek

Function: Principal agency for management of mining and reclamation on state land in Alaska. Maintains a Mining Information Office in Fairbanks. Issues property rights to leasable minerals; adjudicates locatable mineral filings. Issues permits for hard-rock and placer-mining activity. Maintains records of mineral locations, permits, and leases. Provides technical, legal, and land-status information. Administers the Alaska Surface Mining Control and Reclamation Act (ASMCRA), which includes permitting and inspection of coal-mining activity and reclamation of abandoned mines.

Fairbanks Office
3700 Airport Way
Fairbanks, AK 99709
(907) 451-2790
Northern Regional Manager - John Wood
Mining Information Office - Eric Hansen

Juneau Office
400 Willoughby Ave., Ste. 400
Juneau, AK 99801
(907) 465-2478
Mining Information Office

Division of Parks and Outdoor Recreation
3601 C St., Ste. 1200, Frontier Bldg.
P.O. Box 107001 (mailing)
Anchorage, AK 99510-7001
Director - Neils Johannsen

Function: Manages approximately 3,000,000 acres of state park lands primarily for recreational uses, preservation of scenic values, and watershed. Responsible for overseeing mining access, recreational mining activity and valid mining claim inholdings within state park lands.

Northcentral Region
3700 Airport Way
Fairbanks, AK 99709
(907) 451-2695
Regional Manager - Mike Lee

Southcentral Region
3601 C St., Ste. 1280, Frontier Bldg.
P.O. Box 107001 (mailing)
Anchorage, AK 99510-7001
(907) 762-2616
Regional Manager - Al Meiners

History and Archaeology Section
3601 C St., Ste. 1278, Frontier Bldg.
P.O. Box 107001
Anchorage, AK 99510-7001
(907) 762-2626
Section Chief - Judith Bittner
State Historic Preservation Officer
State Archaeologist - Robert Shaw

Southeastern Region
400 Willoughby Ave., Ste. 300
Juneau, AK 99801
(907) 465-4563
Regional Manager - William Garry

DEPARTMENT OF PUBLIC SAFETY
450 Whittier St.
P.O. Box N (mailing)
Juneau, AK 99811
(907) 465-4322
Commissioner - Art English

Division of Fish and Wildlife Protection
5700 East Tudor Rd.
Anchorage, AK 99507
(907) 269-5509
Director - Colonel Jack W. Jordan

Function: Enforce state laws, in particular AS Title 16. Acts as enforcement arm for Alaska Department of Fish and Game.

DEPARTMENT OF REVENUE
State Office Bldg.
11th Fl., Entrance A
P.O. Box S (mailing)
Juneau, AK 99811-0400
(907) 465-2300
Commissioner - Hugh Malone
Income and Excise Tax Audit Division
State Office Bldg.
P.O. Box SA (mailing)
Juneau, AK 99811-0400
(907) 465-2343
Director - Steven E. Kettel
Audit Office Supervisor - Paul Dick

Function: Issues licenses (including mining) for production and sale of minerals.

Division of Audit
State Office Bldg.,
11th Fl., Entrance A
P.O. Box SA (mailing)
Juneau, AK 99811-0400
(907) 465-2320
Director - Steven E. Kettel

Function: Administers mining-license tax, which is based on net income, including royalties. On application, will grant certificate of tax exemption for first year of new mining operations, except for mining of sand and gravel. Tax returns must be filed annually.

UNIVERSITY OF ALASKA
Fairbanks, AK 99775-0760

College of Natural Sciences
Department of Geology & Geophysics
Brooks Bldg., Rm 408
(907) 474-7565
Department Head - Samuel E. Swanson

Function: Provides undergraduate and graduate education in geology and geophysics and conducts basic and applied research in geologic sciences. Offers B.S., M.S., and Ph.D. program options in general geology, economic geology, petroleum geology, geophysics, and ice-snow-permafrost geophysics.

School of Mineral Engineering
Brooks Bldg., Rm. 209
(907) 474-7366
Acting Dean - Russell Ostermann

Function: Provides undergraduate and graduate education programs in geological engineering, mining engineering, mineral preparation engineering, and petroleum engineering. Offers mining extension programs in both urban and rural areas. Through research programs conducts laboratory and field studies to promote mineral and energy development.

Mineral Industry Research Laboratory (MIRL)
O'Neill Resources Bldg., Rm. 210
(907) 474-7135 or 7136
Acting Director - Russell Ostermann
Associate Director - P.D. Rao

Function: Conducts applied and basic research in exploration, development, and utilization of Alaska's mineral and coal resources with emphasis on coal characterization, coal preparation, mineral beneficiation, fine gold recovery, hydrometallurgy, and environmental concerns. Publishes reports on research results and provides general information and assistance to the mineral industry.

Mining Extension Program
Brooks Bldg., Rm. 204
(907) 474-7702
Director - James A. Madonna

Function: Offers prospecting and introductory mineral and mining courses under an open admissions policy.

FEDERAL AGENCIES

U.S. DEPARTMENT OF THE INTERIOR

Bureau of Land Management
Alaska State Office
22 West 7th Ave., #13
P.O. Box 13 (mailing)
Anchorage, AK 99513-7599
State Director - Edward F. Spang
Mineral Resources Deputy State Director - John Santora
(907) 271-3343
Mineral Development Program Leader - Earl Boone
(907) 271-4441
Surface Management Program Leader - Linn Gum
(907) 271-4434
Public Room - (907) 271-5960

Function: Administers federal public lands (except National Parks, Wildlife Refuges, National Monuments, National Forests, and military withdrawals). Issues leases for all federal leasable minerals including oil and gas, coal, phosphates, and oil shale. Arranges for sale of minerals other than leasable or salable materials, including sand, gravel, or stone. Issues right-of-way and special-use permits. Monitors mining operations to insure protection of surface resources. Maintains land-status plats and issues patents. Records federal mining claims and annual assessment affidavits.

Anchorage District Office
6881 Abbott Loop
Anchorage, AK 99507
(907) 267-1200
District Manager - Dick Vernimen

Fairbanks Support Center and Land Information Office (Public Room)

Function: Primary contact for information on Interior and northern regions.

1150 University Ave.
Fairbanks, AK 99709-3844
(907) 474-2250
Support Center Manager - James Murray

Arctic District Office
1150 University Ave.
Fairbanks, AK 99709-3844
(907) 474-2302
Acting District Manager - Charles Joy

Nome Field Office
P.O. Box 952 (mailing)
Nome, AK 99762
Manager - Norm Messenger

Glennallen District Office
P.O. Box 147 (mailing)
Glennallen, AK 99588
(907) 822-3218
District Manager - Gene Keith

Kobuk District Office
1150 University Ave.
Fairbanks, AK 99709-3844
(907) 474-2332
Acting District Manager - Herb Brownell

Steese-White Mountain Office
1150 University Ave.
Fairbanks, AK 99709-3844
(907) 474-2352
District Manager - Roger Bolstad

Kotzebue Field Office
P.O. Box 262 (mailing)
Kotzebue, AK 99752
(907) 442-3430
District Manager - Mary Leykom

Tok Field Office
P.O. Box 309 (mailing)
Tok, AK 99780
(907) 883-5121
Manager - Bob Burritt

U.S. Bureau of Mines
Alaska Field Operations Center
201 East 9th Ave., Ste. 101
Anchorage, AK 99501
(907) 271-2455
Chief - Donald P. Blasko
Branch Chief - Robert B. Hoekzema

Function: Alaska programs are designed to help develop a viable mineral industry in Alaska with an emphasis on strategic minerals. The two main thrusts of the programs are to provide data on mineral reserves needed by government agencies at all levels, but particularly by Congress and land managers, and to generate, accumulate, and supply mineral data to the mining industry. All Alaska projects are parts of mutually supportive programs: Mineral Land Assessment, Minerals Availability, Minerals Policy Analysis, State Activities, and Technology Transfer.

Alaska Technology Transfer Office
201 East 9th Ave., Ste. 101
Anchorage, AK 99501
(907) 271-2455
Juneau Field Office
P.O. Box 20550 (mailing)
Juneau, AK 99802-0550
(907) 364-2111
Assistant Chief - David Carnes

Fairbanks Field Office
794 University Ave.
Fairbanks, AK 99709
(907) 479-4277
Section Supervisor - James C. Barker

U.S. Fish and Wildlife Service
Region 7 Office
1011 East Tudor Rd.
Anchorage, AK 99503
(907) 786-3522
Regional Director - Walter O. Stieglitz
Assistant Regional Director (Fish and Wildlife Enhancement) - Rowan W. Gould

Function: Administers the federal public lands in National Wildlife Refuges, issues special-use permits for activities on refuges, reviews permits and applications for various mining activities on all private and public lands and waters, and provides information to regulatory agencies on fish and wildlife and their habitat. Makes recommendations to regulatory agencies to mitigate adverse environmental impacts.

Fairbanks Fish and Wildlife Enhancement
Ecological Service/Endangered Species Branch
101 12th Ave., Rm. 232
Box No. 20 (mailing)
Fairbanks, AK 99701
(907) 456-0203
Field Supervisor - Paul Gertler

Juneau Fish and Wildlife Enhancement
Federal Bldg., Rm. 417
P.O. Box 21287 (mailing)
Juneau, AK 99802
(907) 586-7240
Field Supervisor - Nevin Holmberg

Anchorage Fish and Wildlife Enhancement
605 West 4th Ave., Rm. 62
Anchorage, AK 99501
(907) 271-2888
Field Supervisor - Robert Bowker

U.S. Geological Survey
4230 University Dr.
Anchorage, AK 99508
(907) 561-1181
Chief, Branch of Alaskan Geology - Donald L. Grybeck

Function: Investigates and reports on physical resources; configuration and character of land surface; composition and structure of underlying rocks; and quality, volume, and distribution of water and minerals. Conducts 1:250,000-scale geologic mapping under the auspices of the Alaska Mineral Resource Assessment Program (AMRAP).

Alaska Distribution Center (for maps and brochures)
Federal Bldg.
101 12th Ave.
Fairbanks, AK 99701
(907) 456-0244

Public Inquiries Office (for information and publications)
4230 University Dr., Rm. 101
Anchorage, AK 99508-4664
(907) 561-1181

National Park Service
Alaska Regional Office
2525 Gambell St.
Anchorage, AK 99503
(907) 257-2643
Regional Director - Boyd Evison
Chief, Minerals Management - Floyd Sharrock
(907) 257-2626
Mining Engineer - Lynn S. Griffiths
(907) 257-2629

Function: Administers lands within the National Park system in Alaska. Manages valid prior-right mining claims in parklands through plans of operation under Mining in Parks Act, National Park Service regulations, and other applicable federal and state laws and regulations.

U.S. DEPARTMENT OF LABOR

Mine Safety and Health Administration
117 107th Ave. NE., Rm. 100
Bellevue, WA 98004
(206) 442-7037
Bellevue Field Office Supervisor - Walter Turner
(administers portions of Alaska south of Yukon River)

Juneau Field Office
Federal Building
107 West 9th
P.O. Box 22477 (mailing)
Juneau, AK 99802
(907) 586-7165
Inspector - David Lilly

Mine Safety and Health Administration
205 North 4th St., Rm. 103
Coeur d'Alene, ID 83814
(208) 667-6680
Coeur d'Alene Field Office Supervisor - Larry Weberg
(administers portions of Alaska north of Yukon River)

Function: Administers health and safety standards to protect the health and safety of metal/nonmetal and coal miners. Cooperates with the State to develop health and safety programs and develops training programs to help prevent mine accidents and occupationally-caused diseases. Under agreement with the Coal Mine Safety and Health office, the MSHA metal/nonmetal section has assumed responsibility for enforcement and training activities at coal mines in Alaska.

Mine Safety and Health Administration
Coal Mine Safety and Health, District 9
P.O. Box 25367, DFC
Denver, CO 80225-0367
(303) 236-2740
District Manager - John M. Demischiei

Function: Administers health and safety standards according to the Code of Federal Regulations to protect the health and safety of coal miners; requires that each operator of a coal mine comply with these standards. Cooperates with the State to develop health and safety programs and develops training programs to help prevent coal or other mine accidents and occupationally caused diseases in the industry.

U.S. DEPARTMENT OF AGRICULTURE

U.S. Forest Service
Regional Office
Federal Bldg.
P.O. Box 21628 (mailing)
Juneau, AK 99802-1628
(907) 586-7847
Regional Forester - Michael A. Barton

Function: Helps meet national mineral and energy needs by encouraging and supporting environmentally sound mineral enterprises on National Forest System lands. Provides joint administration of general mining laws on National Forest system lands with the Bureau of Land Management. Cooperates with Department of Interior agencies in the review and issuance of mineral leases. Issues permits for disposal of sand, gravel, and stone.

U.S. ENVIRONMENTAL PROTECTION AGENCY

Region 10 Headquarters
1200 6th Ave.
Seattle, WA 98101
(206) 442-1200
Acting Regional Administrator - Thomas P. Dunne

Function: Issues National Pollutant Discharge Elimination System (NPDES) permits under the Clean Water Act to regulate effluent discharges. Maintains regulatory and review authority over wetland and NEPA/EIS-related issues.

Alaska Operations Office
222 West 7th Ave., #19
Box 19 (mailing)
Anchorage, AK 99513
(907) 271-5083
Assistant Regional Administrator - Alvin L. Ewing
Environmental Protection Specialist - Jo Drechsler

Alaska Operations Office
3200 Hospital Dr., Ste. 101
Juneau, AK 99801
(907) 586-7619
Chief, State Operations Section - Steven Torok

U.S. DEPARTMENT OF THE ARMY

Corps of Engineers
Regulatory Branch
P.O. Box 898
Anchorage, AK 99506-0898
District Engineer - Col. William W. Kakel
Write: Attention: NPACO-R-S, or
Call: Chief of Compliance Section (907) 753-2712 or (800) 478-2712 (in Alaska only)

Function: Regulates work in navigable waters of United States and discharge of dredged or fill material into United States waters, including wetlands. Examples of regulated mining activities include construction of berms, dikes, diversion pads, stockpiles, and reclamation activities.

COOPERATIVE STATE-FEDERAL AGENCIES

Alaska Land Use Council
1689 C St., Ste. 100
Anchorage, AK 99501
(907) 272-3422
Federal Coordinator - Ron McCoy
State Co-chairman Designee - Robert L. Grogan

Function: Established in 1980 by the Alaska National Interest Lands Conservation Act to further federal-state cooperation, and is comprised of federal, state, and Native decision makers in Alaska. The council is mandated to conduct cooperative studies, develop programs and procedures to implement the Act, and to make recommendations to the federal and state governments on a variety of complicated land management issues in Alaska.

Alaska Public Lands Information Center
250 Cushman St., Ste. 1A
Fairbanks, AK 99701
(907) 451-7352
Manager - Karla Zervos
Assistant Manager - Chuck Lennox

Function: Clearinghouse for general information about land and resources in Alaska. Information sources include U.S. Forest Service, U.S. Fish and Wildlife Service, U.S. Bureau of Land Management, U.S. Geological Survey, Alaska Departments of Natural Resources and Fish and Game, and Alaska Division of Tourism.

BOARDS AND COMMISSIONS

Alaska Minerals Commission
P.O. Box 80148
Fairbanks, AK 99708
(907) 479-6240
Chairman - Earl H. Beistline

Function: The Mineral Commission was created by the Alaska State Legislature in 1986 to make recommendations to the Governor and the Legislature on ways to mitigate constraints on the development of minerals in Alaska. The Commission has published reports in January 1987, January 1988, January 1989.

Citizens' Advisory Commission on Federal Areas
515 7th Ave., Ste. 310
Fairbanks, AK 99701
(907) 456-2012
Chairperson - Dorothy Jones
Executive Director - Stan Leaphart
Administrative Assistant - Michael Welsh

Function: The Citizens' Advisory Commission on Federal Areas was established in 1981 by the Alaska Legislature to protect the rights of Alaskans to continue their traditional uses of federal lands throughout the state. This was done in response to Congressional enactment in December 1980 of the Alaska National Interest Lands Conservation Act (ANILCA) which placed millions of acres of federally owned lands into Conservation System Units with restrictive land-use and management requirements.

Alaska Water Resources Board
P.O. Box 107005
Anchorage, AK 99510
Chairperson - Peg Tileston
(907) 561-0540
Water Resource Board Coordinator - Mary Lou Harle
(907) 762-2680

Function: The Alaska Water Resources Board serves as an advisory group to the Governor on all matters relating to use and appropriation of water in the state of Alaska. The board has been particularly supportive of water resources legislation, including amendments to the Alaska Water Use Act for reservations of water and instream uses, basin-wide water rights adjudications, and housekeeping amendments to improve water-rights adjudication. The board has taken a keen interest in the state's water quality programs and water quality standards.

CHAMBERS OF COMMERCE

Alaska State Chamber of Commerce
801 B St., Ste. 405
Anchorage, AK 99501
(907) 278-2722
Chairman - Don Thornlow
President - George Krusz
Regional Manager - Kathleen Tarr

Juneau Branch
217 - 2nd St., Ste. 201
Juneau, AK 99801
(907) 586-2323)

Function: The State Chamber of Commerce researches and formulates positions on Alaskan resource development. Recommendations for consideration are submitted to the State Chamber of Commerce Board of Directors.

Greater Fairbanks Chamber of Commerce
Mineral Development Committee
P.O. Box 74446
Fairbanks, AK 99707
(907) 452-1105
Co-Chairmen - Paul Metz, Rocky Rhodes

Function: Supports the placer-mining industry, vocational education, RS2477 Rights-of-way, and government agencies that support and perform research in mineral development.

Anchorage Chamber of Commerce
437 E St., Ste. 300
Anchorage, AK 99501

Natural Resource Committee
Chairman - Dave Cuddy
Coal and Minerals Subcommittee
941 East Dowling Rd., Ste. 300
Anchorage, AK 99518
(907) 562-4673

Function: Monitors and supports mining activity in southcentral Alaska area as well as activities statewide that impact Anchorage.

NONGOVERNMENTAL GROUPS AND ASSOCIATIONS

Alaska Miners Association, Inc.
Statewide Office
501 West Northern Lights Blvd., Ste. 203
Anchorage, AK 99503
(907) 276-0347
Statewide President - Neil MacKinnon
Executive Director - Steven C. Borell

Anchorage Branch
Chairman - Kevin Adler
501 West Northern Lights Blvd.,
Ste. 203
Anchorage, AK 99503
(907) 274-6473

Fairbanks Branch
Chairperson - Susan Knapman
P.O. Box 73069
Fairbanks, AK 99707
(907) 451-6650

Juneau Branch
Chairman - Rick Fredericksen
P.O. Box 21684
Juneau, AK 99802
(907) 364-3144

Kenai Branch
Chairman - Dennis Steffy
c/o Mining & Petroleum Training Service (MAPTS)
155 Smith Way, Ste. 104
Soldotna, AK 99669
(907) 262-2788

Nome Branch
Chairman - Joe Fisher
P.O. Box 242
Nome, AK 99762
(907) 443-5272

Alaska Women in Mining
Fairbanks Branch
Sandra Stillion, President
P.O. Box 83542
Fairbanks, AK 99708
(907) 451-8448

Anchorage Branch
Denise Herzog, President
P.O. Box 240334
Anchorage, AK 99524

Society of Mining Engineers
Caller No. D
Littleton, CO 80162-5002
(303) 973-9550

Alaska Section
Chairman - Richard Swainbank
1001 Noble St., Ste. 360
Fairbanks, AK 99701
(907) 452-7464

Southern Alaska Branch
Chairman - Will White
4200 University Dr.
Anchorage, AK 99508
(907) 786-7435

American Institute of Professional Geologists
7828 Vance Dr., Ste. 103
Arvada, CO 80003
(303) 431-0831

Dr. Robert Sanders, President
Alaska Section
11661 Rock Ridge Rd.
Anchorage, AK 99516
(907) 345-0203

Miners Advocacy Council
John Korobko, President
P.O. Box 73824
Fairbanks, AK 99707
(907) 479-0471

Northwest Mining Association
William C. Booth, President
414 Peyton Bldg.
Spokane, WA 99201
(509) 624-1158

Placer Miners of Alaska
Dennis Higgins, President
P.O. Box 73756
Fairbanks, AK 99707
(907) 455-6059

Resource Development Council for Alaska, Inc.
Pete Nelson, President
Becky L. Gay, Executive Director
807 G St., Ste. 200
P.O. Box 100516 (mailing)
Anchorage, AK 99510-0516
(907) 276-0700

Western Mining Council
Kenai Peninsula Chapter
Oscar H. Bailey, President
Old Nash Rd.
Seward, AK 99664
(907) 224-5963

ORGANIZED MINING DISTRICTS

Chistochina Mining and Recording District
Del Ackels, President
P.O. Box 2151
Fairbanks, AK 99708

Circle Mining and Recording District
Susan Knapman, President
P.O. Box 1273
Fairbanks, AK 99707

Fairbanks Mining District
Don Stein, President
105 Dunbar
Fairbanks, AK 99701

Forty-Mile Miners Association
Mike Busby, President
P.O. Box 71
Chicken, AK 99732

Juneau Mining District
Dr. Roger Eichman, President
P.O. Box 20765
Juneau, AK 99802

Kantishna Mining District
Sam Koppenburg, President
SRD Box 9070
Palmer, AK 99645

Iditarod Mining District
John Miscovich, President
1093 North Greengrove St.
Orange, CA 92667

Livengood-Tolovana Mining District
Rose Rybachek, President
P.O. Box 55698
North Pole, AK 99707

Seward Mining District
Tom Williams, President
Box 66
Hope, AK 99605

Valdez Mining District
Claude Morris, President
P.O. Box 547
Girdwood, AK 99587-0547

Yentna Mining District
John Jacobsen, President
700 Ash Pl.
Anchorage, AK 99501

APPENDIX C
Selected significant mineral deposits in Alaska (locations shown in figs. 57 through 59)[a]

Map no.

1 **Lik-Su** - Major strata-bound massive sulfide (Zn-Pb-Ag-Cd-Ba) deposits in black shale and cert. Proven reserve (Lik) estimate of 24 million tons of 9 percent Zn, 3.1 percent Pb, and 1.4 oz/ton Ag.

2 **Red Dog** - At least two major strata-bound massive sulfide deposits hosted in Pennsylvanian or Mississippian shale; similar to locality 1. Main deposit at Red Dog contains at least 85 million tons of 17.1 percent Zn, 5 percent Pb, 2.4 oz/ton Ag; nearby Hilltop deposit contains significant undisclosed reserves.

3 **Drenchwater** - Mississippian and Lisburne Group shales and cherts contain three strata-bound base metal occurrences spatially related to acid volcanics. In the lowest unit a siliceous mudstone contains a 2-ft layer with up to 23 percent zinc. An overlying gray chert contains up to 11 percent zinc and up to 5 percent lead with some silver in fracture fillings. At the top of the overlying tuffaceous layer silver-bearing zinc and lead mineralization outcrops discontinuously for at least 6,500 ft, and contains up to 26 percent zinc and 51 percent lead in a grab sample.

4 **Ginny Creek** - Epigenetic, disseminated Zn-Pb-Ag deposits with barite in sandstone and shale of Noatak Sandstone of Late Devonian through Early Mississippian age. Random grab samples of surface float contain 0.3 to 3.0 percent Zn and highly variable amounts of Pb and Ag.

5 **Story Creek** - Epigenetic replacement deposits of Zn-Pb-Ag-Cu-Au hosted in brecciated zones in Devonian Kanayut Conglomerate or Lower Mississippian Kayak Shale. Grab samples of high-grade material contain up to 0.43 percent Cu, 34 percent Pb, 28.8 percent Zn, 0.04 oz/ton Au, and 30 oz/ton Ag.

5A **Kivliktort Mountain** - Mineralized float in widespread on the north flanks of the mountain, apparently spatially related to the contact between shales at the base of the hills and coarse-grained siliceous clastic rocks on the upper slopes. Rock samples containing up to 30 percent zinc have been reported.

6 **Whoopee Creek** - Epigenetic replacement deposits of Zn-Pb-Cu-Ag-Au-Cd in breccia zones in Devonian Kanayut Conglomerate or Lower Mississippian Kayak Shale. Random grab samples of mineralized material contain 0.24 percent Cu, 0.37 percent Cd, 46 percent Zn, 44 percent Pb, 0.14 oz/ton Au, and 14.8 oz/ton Ag.

7 **Omar** - Epigenetic replacement deposits of Paleozoic age; include bedded barite occurrences. Grab samples contain 15.3 percent Cu, 0.15 percent Pb, 0.95 percent Zn, 0.05 percent Co, and 0.3 oz/ton Ag.

7A **Frost** - Possible 9 million tons barite in pods, lenses and wavey-banded quartz-calcite-barite veins. Chalcopyrite and galena occur in the veins which cross cut Paleozoic limestone and dolomite for a minimum distance of 1 mile. Samples contain up to 13.2 percent Zn.

8 **Bornite** - Major strata-bound Cu-Zn deposit in brecciated carbonate rock of Devonian age; 4.56 million ton orebody contains 4.0 percent Cu and accessory Zn and Co. Larger reserve estimate of 36.2 million tons of about 2 percent Cu and undisclosed amount of Zn and Co. At grade of 1.2 percent Cu, reserves are 100 million tons.

9 **Arctic** - Major volcanogenic (Cu-Zn) massive sulfide deposit hosted in sequence of metarhyolite, metatuff, and graphitic schist of Devonian age; indicated reserves of 35 to 40 million tons grade 4.0 percent Cu, 5.5 percent Zn, 0.8 percent Pb, 1.6 oz/ton Ag, and 0.02 oz/ton Au.

10 **Sun** - Major (Cu-Pb-Zn-Ag) massive sulfide deposit in sequence of middle Paleozoic metarhyolite and metabasalt; indicated 1976 gross-metal value of Cu, Pb, Zn, and Ag was over $1 billion. Average grades are 1-4 percent Pb, 6-12 percent Zn, 0.5-7 percent Cu, 3-11 oz/ton Ag.

11 **Smucker** - Middle Paleozoic volcanogenic massive sulfide deposit; 3,000 ft long and up to 190 ft wide contains significant tonnage of Cu-Pb-Zn ore that grades 1.5 percent Pb, 5 to 10 percent Zn, 3 to 10 oz/ton Ag, with minor Au.

12 **Avan Hills** - Disseminated chromite in layered ultramafic rocks; grab samples contain up to 4.3 percent Cr with 0.015 oz/ton PGM.

13 **Misheguk Mountain** - Chromite occurrences similar to those in Avan Hills.

14 **Klery Creek** - Lode and placer Au deposits worked intermittently from 1909 through 1930s. Total production through 1931, mostly from placer deposits, estimated at 31,320 oz.

15 **Ernie Lake** - (Ann Creek) Strata-bound massive sulfide occurrence in metarhyolite, metatuff, and marble. Gossan zones strongly anomalous in Cu-Pb-Zn and Ag.

16 **Koyukuk-Nolan mining district** - Major placer Au district; from 1893 to present, produced more than 300,000 oz Au. Significant deep placer reserves remain.

17 **Chandalar mining district** - Major Au producing district; substantial production in excess of 30,000 oz Au from lode and placer sources; lode gold found in crosscutting quartz veins that intrude schist and greenstone. Active development of placer deposits and lodes in progress. Estimated 45,000 tons at 2-4 oz/ton in partially explored veins.

18 **Porcupine Lake** - Stratiform fluorite occurrences and argentiferous enargite, tetrahedrite associated with felsic volcanic rocks of late Paleozoic age. Reported grades of up to 25 to 30 percent fluorite reported, with grab samples of 4.8 percent Cu and 0.2 percent silver.

[a]This generalized summary does not describe all the 6,400 mineral occurrences and deposits known in Alaska. In cooperation with DGGS, the U.S. Geological Survey released Bulletin 1786: "Significant metalliferous lode deposits and placer districts in Alaska" (Nokleberg and others, 1987), which describes 262 significant metalliferous lodes and 43 placer districts.

19 **Wind River** - Strata-bound Pb-Zn massive sulfide prospects; reported grades of up to 5 percent Pb.

20 **Esotuk Glacier** - Disseminated Mo-Sn-W-Pb-Zn mineralization in skarns associated with Devonian(?) schistose quartz monzonite. Grab samples contain up to 0.08 percent Sn and 0.15 percent W.

21 **Bear Mountain** - Major stockwork Mo-W-Sn occurrence in intrusive breccia. Rock samples containing up to 0.8 percent molybdenum and 0.6 percent W occur within a 35 acre area where soil samples average more than 0.2 percent MoS_2, and an adjacent 25 acre area where rubble contains wolframite has soils averaging greater than 0.12 percent WO_3. Rubble crop in this area indicates a Tertiary porphyry system as the source of the molybdenum and tungsten.

21A **Galena Creek** - steeply dipping veins contain up to 21 percent Cu, 3.5 percent Zn, and 1.3 percent Pb with 5-1/2 oz/ton Ag on the east side of the creek, and a large area of disseminated mineralization and veinlets contains predominantly zinc on the ridge west of the creek.

22 **Cape Creek** - Major placer Sn producer. More than 500 tons Sn produced from 1935 to 1941; at least 500 tons produced in last 10 yr. Derived from Cape Mountain in contact zone of Cretaceous granite.

23 **Buck Creek** - Major placer Sn producer. More than 1,100 tons Sn produced from 1902 to 1953.

24 **Lost River** - Major Sn, fluorite, W, and Be deposit associated with Cretaceous Sn granite system. More than 350 tons Sn produced from skarn and greisen lode sources. Measured reserves amount to 24.6 million tons that grade 0.15 percent Sn, 16.3 percent CaF_2, and 0.03 percent WO_3, based on 45,000 ft of diamond drilling.

25 **Ear Mountain** - Placer Sn district and Sn-Cu-Au-Ag-Pb-Zn skarn mineralization of Cretaceous age. Area also anomalous in uranium.

26 **Kougarok Mountain** - Sn deposit hosted in quartz-tourmaline-topaz greisen of Cretaceous age. Grades may average 0.5 percent Sn and 0.01 percent Ta and Nb, but a high grade resource of 150,000 tons grading 1 percent + has been identified.

27 **Hannum** - Stratiform, carbonate hosted Pb-Zn-Ag massive sulfide deposit of middle Paleozoic age in heavily oxidized zone that ranges from 30 to 150 ft thick. Mineralized zone reported to assay up to 10 percent Pb, 2.2 percent Zn, 0.04 oz/ton Au, and 1.76 oz/ton Ag.

28 **Independence Creek** - Pb-Zn-Ag massive sulfide deposit; high-grade ore shipped in 1921 contained 30 percent Pb, 5 percent Zn, and 150 oz/ton Ag. Mineralization restricted to shear zone in carbonates

29 **Sinuk River** - Stratiform Pb-Zn-Ag-Ba-F massive sulfide deposits and layered iron deposits of Precambrian or Paleozoic age. Mineralized zones extend over 8,000 ft along strike.

30 **Nome mining district** - Major placer Au and lode Au producer. Production in excess of 4,348,000 oz Au. Sporadic Sb and W production in past.

31 **Rock Creek** - About 6.6 million tons grading 0.072 oz/ton Au in vein swarms and strangers in an area 1,500 ft long, 500 ft maximum width and 300 ft deep.

32 **Big Hurrah** - Epigenetic vein deposit in black slate and metasediments of York Slate. Deposit contains some W mineralization and has produced over 20,000 oz Au from nearly 50,000 tons milled ore. Proven, inferred, and indicated reserves total 104,000 tons that grade 0.61 oz/ton Au, 0.55 oz/ton Ag, and credits of WO_3.

33 **Solomon mining district** - Major placer Au district; produced over 250,000 oz Au.

34 **Kachauik** - Uranium prospect in Cretaceous alkalic intrusive rocks. Highly anomalous geochemical values and U concentrations of 1,000 ppm reported.

35 **Omalik** - Stratiform or vein-type Pb-Zn-Ag massive sulfide prospect in Paleozoic carbonate rocks; from 1881 to 1900, produced 300 to 400 tons of Pb-Zn ore that averaged about 10 percent Pb and 40 oz/ton Ag. Grades of oxidized Zn ore reported to be up to 34 percent Zn.

36 **Windy Creek** - Disseminated Mo-Pb-Zn mineralization in quartz veins and skarns with reported values as high as 0.15 percent Mo.

37 **Quartz Creek** - Significant Pb-Zn-Ag mineralization; reported grades of 15 percent combined Pb-Zn and 10 oz/ton Ag.

38 **Placer River** - Significant Mo-F mineralization disseminated in intrusive rocks. Reported values of 0.2 percent Mo.

39 **Candle Creek** - Placer Au deposits with significant reserves. Placer concentrates reported to have significant U and galena concentrations.

40 **Poovookpuk Mountain** - Porphyry Mo mineralization. Reported grades of up to 0.25 percent Mo.

41 **Purcell Mountain** - Mo and Ag occurrences associated with Cretaceous alkalic igneous plutons, alaskite, and bostonite dikes.

42 **Koyukuk-Hughes mining district** - Production of 230,000 oz Au from 1930 to 1975, mainly from Alaska Gold dredging operation at Hogatza; dredge reactivated in 1981, but deactivated in 1984. Non-float mechanized operation on Utopia Creek produced significant amount of placer Au from 1930 to 1962.

43 **Flat mining district** - Major placer Au district; produced 1,535,701 oz Au through 1986. Potential exists for occurrence of significant lode-Au and lode-W reserves at Golden Horn deposit and other known lodes in region associated with shear zones and monzonite intrusive rocks of Late Cretaceous age.

43A **Innoko-Tolstoi mining district** - Major placer Au district with significant lode Au-Sb-Hg potential; lode sources for placers are volcanic-plutonic complexes of Late Cretaceous age and dike swarms that intrude Mesozoic flysch; mining district produced 582,432 oz Au from placer deposits.

44 **Nixon Fork** - Promising Au-Cu deposits; Nixon Fork mine produced 57,000 oz Au from Late Cretaceous skarns associated with quartz monzonite-Devonian limestone contact zones. Probable reserve of 320,000 oz gold in 285,000 tons of ore.

44A **Illinois Creek** - 1.7 million tons of 0.071 oz/ton gold and 2.05 oz/ton silver. An epigenetic(?) and replacement deposit with Cu-Pb-Zn-Ag-Au associated with altered quartz monzonite porphyry and schist.

45 **Bonanza Creek** - Skarn-type W mineralization along intrusive contact; no published information available.

46 **Ruby mining district** - Placer Au-Sn district; produced more than 420,000 oz Au from 1931 to 1960; mining district also contains Pb-Ag prospects with grades reportedly as high as 82 oz/ton Ag.

47 **Hot Springs mining district** - Placer Au-Sn district; produced more than 450,000 oz Au and over 720,000 lb cassiterite through 1981. Includes Eureka and Tofty subdistricts.

48 **Livengood-Tolovana mining district** - Placer Au district; produced more than 448,000 oz Au since discovery in 1914. Substantial reserves remain.

49 **Fairbanks mining district** - Seventh largest Au-producing district in United States; largest producer in Alaska. Produced about 8,000,000 oz Au from placer deposits. Major lode Au and lode Sb producer; produced more than 285,000 oz Au and over 4 million lb Sb from veins and shear zones through 1970. Production of W exceeded 4,000 tons since 1915, all derived from tactite and skarn near Cretaceous quartz monzonite. Reserves of 3.6 to 4.1 million ounces of gold have been identified at the partially explored Fort Knox property about 15 miles northeast of Fairbanks. This deposit is hosted in 80- to 100-million tons of granodiorite. Numerous other veins and stockworks are being actively explored throughout this district.

50 **Mt. Prindle** - Significant uranium-rare earth mineralization in Mesozoic alkaline igneous rocks. Rock geochemical values of up to 0.7 percent uranium; up to 15 percent rare earth elements reported.

51 **Twin Mountain** - Significant W mineralization associated with skarn development along contact zone of quartz monzonite stock of Cretaceous age.

52 **Circle mining district** - Currently Alaska's largest producing placer Au district; produced 917,500 oz Au since discovery in 1893. Has significant potential for Sn, W, and Au mineralization from variety of lode sources.

53 **Three Castle Mountain, Pleasant Creek, Casca VABM** - Strata-bound Pb-Zn massive sulfide mineralization. Reported grades of up to 17 percent Zn and 2 percent Pb.

54 **Totatlanika River lode zone, Anderson Mountain, Dry Creek, Virginia Creek** - Significant volcanogenic Cu-Pb-Zn-Ag massive sulfide deposits of Devonian to Mississippian age in Bonnifield mining district. Potential for high-grade deposits reported. Includes Liberty Bell strata-bound Au deposit and Sheep Creek; latter contains Sn and base metals.

55 **Delta massive sulfide belt** - Contains at least 30 known volcanogenic massive sulfide deposits and occurrences. Grades from 0.3 to 1.1 percent Cu, 1.7 to 5.7 percent Zn, 0.5 to 2.3 percent Pb, 0.7 to 2.0 oz/ton Ag, and 0.018 to 0.061 oz/ton Au; estimated potential reserve of 40 million tons for all deposits.

56 **Mosquito, Peternie** - Porphyry Mo prospects of early Tertiary age; reported grades of up to 0.17 percent Mo.

57 **Taurus** - Major porphyry Cu-Mo prospect of Paleocene age with at least 500 million tons of mineralization. Reported potential for large tonnage of 0.5 percent Cu and 0.05 percent Mo.

58 **Big Creek, Ladue** - Strata-bound Pb-Zn-Ag massive sulfide prospects in metavolcanic rocks.

59 **Slate Creek** - At least 55 million tons of 6.3 percent, high-quality chrysotile asbestos in serpentinized ultramafic rocks of Permian(?) age.

60 **Fortymile mining district** - Major placer Au district. Produced over 501,000 oz Au since discovery in 1886.

61 **Kantishna mining district** - Major placer Au and lode Ag-Au-Pb-Zn-Sb-W district. Produced more than 92,000 oz placer Au, about 260,000 oz lode Ag, and several million lb Sb from shear zones and vein deposits hosted in Precambrian metamorphic units. Potential exists for significant Ag-Au-Pb-Zn deposits. Metalliferous strata-bound deposits occur in schist and quartzite.

62 **Stampede mine** - Major Sb deposit; produced more than 3.5 million lb Sb from large shear zone in Precambrian metamorphic rocks.

63 **Purkypile** - Significant Ag-Sn-Be mineralization associated with "McKinley" pluton (55 Ma. old). Grades of up to 4.5 percent Sn reported. Potential exists for U and W mineralization.

64 **Golden Zone mine** - Major Au-Cu-Ag deposits in Late Cretaceous breccia pipe. Produced more than 1,581 oz Au, 8,617 oz Ag, and 42,000 lb Cu. Estimated reserves are 230,000 contained ounces of gold.

65 **Nim Prospect** - Porphyry Cu-Ag-Au deposit of Late Cretaceous age. Reported grades of up to 5.0 percent Cu and 9 oz/ton Ag.

66 **Coal Creek** - Greisen-hosted Sn-Cu-W deposit in "McKinley" age pluton (55 Ma. old). Reported reserves of 5 million tons of ore that grade 0.28 percent Sn and 0.3 percent Cu with credits of W, Ag, and Zn.

66A **Valdez Creek** - 316,000 ounces of proven and probable reserves plus 313,000 ounces of possible in paleoplacer channels.

67 **Denali Prospect** - At least six small, strata-bound Cu lodes in volcanic sedimentary rocks of Triassic age that may contain 5 million tons ore that grade about 2 percent Cu with credits of Ag.

68 **Chistochina** - Porphyry Cu prospects of Tertiary age and placer Au district; produced more than 177,000 oz Au and small amount Pt from placer deposits.

69 **Nabesna mine** - Classic high-grade Au skarn that envelopes quartz diorite of Jurassic(?) age; produced over 66,960 oz Au from about 88,000 tons of ore from 1930 to 1941.

70 **Spirit Mountain** - Massive and disseminated Cu-Ni mineralization in mafic-ultramafic complex.

71 **Kennecott deposits** - Major stratiform Cu-Ag massive sulfide deposits localized near contact between Chitistone Limestone and Nikolai Greenstone of Triassic age; contained some of highest grade Cu lodes mined in North America. From 1911 to 1938, produced more than 1.2 billion lb Cu and 10 million oz Ag from 4.8 million tons ore. Some reserves remain.

72 **Binocular and other prospects** - Kennecott-type Cu-Ag massive sulfide deposits.

73 **Bond Creek - Orange Hill** - Two major porphyry Cu-Mo deposits of Late Cretaceous age; reported inferred reserves of 850 million tons ore that grade 0.3 to 0.5 percent Cu and 0.03 percent Mo.

74 **Carl Creek** - Porphyry Cu prospect in altered intrusive complex; similar to locality 73.

75 **Baultoff** - Porphyry Cu prospect in altered intrusive rocks; inferred reserves of 145.1 million tons of 0.20 percent Cu similar to locality 73.

76 **Horsfeld** - Porphyry Cu prospect; similar to locality 73.

77 **Midas mine** - Significant strata-bound Cu (Ag-Au-Pb-Zn) massive sulfide deposit in volcanic sedimentary rocks of Tertiary Orca Group. Produced more than 3.3 million lb Cu from 49,350 tons ore.

78 **Ellamar** - Strata-bound Cu-Zn-Au massive sulfide deposit in sediment of Eocene(?) Orca Group. Produced more than 16 million lb Cu, 51,307 oz Au, and 191,615 oz Ag from about 301,835 tons ore.

79 **Willow Creek, Independence, Lucky Shot, War Baby** - Major lode Au (Ag-Cu-Pb-Zn-Mo) in veins that cut Mesozoic quartz diorite. Produced more than 448,082 oz Au from lode sources and about 35,000 oz Au from associated placer deposits.

80 **Latouche, Beatson** - Major strata-bound Cu-Zn-Ag massive sulfide deposits in Orca Group sedimentary rocks and mafic volcanic rocks. Produced more than 205 million lb Cu from 6 million tons ore. Inferred reserves of 4.53 million tons ore that grade 1 percent Cu, 1.5 percent Pb+Zn, and 1 oz/ton Ag may remain.

81 **Rua Cove** - Major strata-bound Cu-Zn massive sulfide deposit in complex ore shoots enclosed in mafic volcanic rocks of Orca Group. Reported reserves of over 1.1 million tons ore that grade 1.25 percent Cu.

82 **Red Mountain** - Significant Cr occurrence associated with layered ultramafic complex of Tertiary age at Red Mountain near Seldovia. More than 36,000 tons metallurgical-grade ore shipped through 1976; huge low-grade chrome resource may remain, of which 30 million tons grade 5.1 percent Cr_2O_3.

83 **Red Devil** - Major Hg-Sb deposit; moderate-grade ore hosted in shear zones in Kuskokwim Group sedimentary rocks. More than 35,000 flasks Hg produced from 75,000 tons ore.

84 **Nyac mining district** - Significant placer Au district. Aniak mining district (of which Nyac is a part) produced more than 230,000 oz Au from placer deposits.

85 **Goodnews Bay** - Major placer Pt district; estimated to have produced over 540,000 oz refined Pt-group metals from 1934 to 1976; one of the largest known Pt-group metal resources in United States. Possible reserves of 60 million yd^3 of deep, Pt-bearing gravels remain. Lode source believed to be Alaskan-type zoned ultramafic complex of Cretaceous age.

86 **Apollo-Sitka mines** - Major lode Au deposits; produced more than 107,900 oz Au from ore that averaged about 0.22 oz/ton Au. Inferred reserves may amount to 748,000 tons that grade 0.76 oz/ton Au, 2.16 oz Ag, and several percent base metal.

87 **Pyramid** - Late Tertiary porphyry Cu-Mo deposit; inferred reserves of 125 million tons ore that grade 0.4 percent Cu and 0.03 percent Mo reported.

88 **Ivanof** - Late Tertiary porphyry Cu prospect; grades of up to 0.72 percent Cu reported. Potential for large tonnages.

89 **Weasel Mountain, Bee Creek** - Porphyry Cu-Mo prospect of late Tertiary to Quaternary age; grades of up to 0.48 percent Cu and 0.035 percent Mo reported. Potential for moderate tonnages of low-grade mineralization.

90 **Mike deposit** - Porphyry Mo prospect of late Tertiary age; grades of up to 0.21 percent Mo reported. Potential for large tonnages of low-grade Mo mineralization.

91 **Rex deposit** - Porphyry Cu prospect similar to locality 90; grades of up to 0.3 percent Cu reported. Potential for moderate reserves of low-grade mineralization.

92 **Kasna Creek** - Major stratiform Cu-Pb-Zn and skarn-sulfide deposits of Mesozoic age in mafic, volcanic, and sedimentary rocks; reported reserves of over 10 million tons ore that grade more than 1 percent Cu.

93 **Sleitat Mountain** - High grade grade east-west-trending, topaz-quartz-tin-tungsten greisen system hosted in 57 Ma. old binary granite and in hornfels. Zone up to 3,000-ft-long and 500-ft-wide. One drill-hole showed 85 ft of 1.8 percent tin, 0.4 percent tungsten.

94 **Jimmy Lake** - Complex Cu-Ag-Sn mineralization of late Tertiary(?) age; reported grades of up to 105 oz/ton Ag and 3 percent Cu.

95 **Haines Barite** - Major stratiform Ba-Pb-Zn-Cu-Ag deposit in pillow basalt-dominated section of Paleozoic or Triassic age; consists of 48- to 60-ft-thick zone of 60-percent barite with upper zone (2 to 8 ft thick) of massive sulfides that contain 2 percent Pb, 3 percent Zn, 1 percent Cu, 2 to 4 oz/ton Ag, and 0.12 oz/ton Au. Estimated to contain 750,000 tons of 65 percent barite with metal credits.

96 **Klukwan** - Major Fe-Ti deposits in zoned ultramafic complex of Mesozoic age; reported to contain 3 billion tons of material that contain 16.8 percent Fe and 1.6 to 3.0 percent Ti.

97 **Nunatak** - Porphyry Mo deposit; reported reserves of 8.5 million tons ore that grade 0.125 percent Mo and 129 million tons of 0.04 percent Mo.

98 **Brady Glacier** - Major Ni-Cu deposit in layered gabbro-pyroxenite complex of Tertiary age. Proven reserves of 100 million tons ore that grade 0.5 percent Ni and 0.3 percent Cu reported; also contains significant Co and Pt concentrations.

99 **Mertie Lode and Funter Bay mining district** - Contains substantial reserves of lode Au mineralization. Past production totaled 10,000 to 15,000 oz Au. Deposits also contain significant Ni-Cu and Pb-Zn-Ag mineralization. Funter Bay deposit contains reported reserves of 560,000 tons that grade 0.34 percent Ni, 0.35 percent Cu, and 0.15 percent Co in gabbro-pipe system.

100 **Alaska-Juneau** - Major lode Au deposit that consists of 100- to 300-ft wide zone that contains enechelon, gold-bearing quartz veins in metamorphic rocks; produced more than 3.52 million oz Au from 88.5 million tons ore from 1893 to 1944. Reserves of 29 million tons of 0.039 oz/ton gold remain.

101 **Chichagof and Hirst Chichagof** - Major lode-Au deposits in quartz veins that cut Mesozoic graywacke; produced more than 770,000 oz Au. Chichagof mine produced about 700,000 oz Au and 200,000 oz Ag; Hirst Chichagof mine produced about 67,980 oz Au and 20,000 oz Ag. Reserves estimated to be 900,000 oz Au with 100,000 oz defined.

102 **Mirror Harbor** - Ni-Cu mineralization in layered-gabbro complex of Mesozoic age; reported probable reserves of 8,000 tons of 1.57 percent Ni and 0.88 percent Cu and reported inferred reserves of several million tons ore that grade 0.2 percent Ni and 0.1 percent Cu.

103 **Bohemia Basin** - Major Ni-Cu-Co mineralization in layered mafic complex similar to locality 102; reported reserves of 22 million tons ore that grade 0.33 to 0.51 percent Ni, 0.21 to 0.27 percent Cu, and 0.02 percent Co.

104 **Apex-El Nido** - Significant lode Au-W deposits that occur as cross-cutting veins in graywacke; produced more than 50,000 oz Au.

105 **Greens Creek** - Major sediment-hosted Pb-Zn-Cu-Ag-Au volcanogenic massive sulfide deposit of Devonian or Triassic age; most recent reserve estimate is 3.6 million tons ore that grades 25.3 oz/ton Ag, 0.16 oz/ton Au, 10.8 percent Zn, and 4.1 percent Pb.

106 **Sumdum** - Volcanogenic Cu-Pb-Zn massive sulfide deposit in Mesozoic metamorphic complex with potential strike length of over 10,000 ft. Inferred reserves of 26.7 million tons ore that grade 0.57 percent Cu, 0.37 percent Zn, and 0.3 oz/ton Ag reported.

107 **Snettisham** - Fe-Ti deposit in mafic zoned-intrusive complex; reported grades of about 18.9 percent Fe and 2.6 percent Ti.

108 **Tracy Arm** - Strata-bound Cu-Zn-Pb massive sulfide prospect in Mesozoic schist; over 1,100 ft long and up to 12 ft thick. Reported grades of 1.5 percent Cu, 3.9 percent Zn, 0.76 oz/ton Ag, and 0.013 oz/ton Au.

109 **Red Bluff Bay** - Significant chrome mineralization in Mesozoic ultramafic complex (probably ophiolite); reported reserves of 570 tons of material that grade 40 percent Cr and 29,000 tons that grade 18 to 35 percent Cr.

110 **Cornwallis Peninsula** - Volcanogenic Cu-Pb-Zn-Ag-Ba massive sulfide deposit of Triassic(?) age; reported grades of up to 20 percent Pb-Zn and 23 oz/ton Ag.

111 **Castle Island** - Stratiform barite deposit of Triassic age hosted in carbonate and pillow basalt; about 856,000 tons of raw and refined barite produced from 1963 to 1980; also contains Zn, Pb, and Cu sulfides. Reported to be mined out.

112 **Ground Hog Basin** - Area contains several stratiform massive sulfide prospects in Mesozoic schist and gneiss whose origins are unknown. Reported grades of up to 8 percent Pb, 29 oz/ton Ag, and 0.5 oz/ton Au. Area also contains potential for porphyry Mo deposits.

113 **Snipe Bay** - Ni-Cu deposit in zoned mafic-ultramafic complex; inferred reserves of 430,000 tons of 0.3 percent Ni, 0.3 percent Cu, and 0.13 oz/ton Ag reported.

114 **Kasaan Peninsula** - Major skarn-type Cu-Fe-Au massive sulfide deposit of Jurassic age; area has produced over 28 million lb Cu and 55,000 oz Ag. Reported reserves of 4 million tons ore that grade 50 percent Fe and less than 2 percent Cu.

115 **Salt Chuck** - Cu-PGM-Ag-Au deposit in contact zone between pyroxenite and gabbro within Alaskan-type zoned mafic-ultramafic pluton. From 1900 to 1941, 5 million lb Cu, over 20,000 oz PGM, and Au and Ag credits were produced from 325,000 tons ore.

116 **Union Bay** - Significant Fe-Ti mineralization in ultramafic complex; area also contains Pt and V concentrations.

117 **Hyder mining district** - Area produced more than 25,000 tons high-grade W-Cu-Pb-Zn-Ag ore from 1925 to 1951 from crosscutting ore shoots in Texas Creek granodiorite of Tertiary age. Area also contains potential for porphyry Mo-W mineralization and massive sulfide-skarn Pb-Ag-Au-W deposits.

118 **Jumbo** - Cu-Fe-Mo-Ag skarn deposit; produced more than 10 million lb Cu, 280,000 oz Ag, and 7,000 oz Au from 125,000 tons ore from classic, zoned magnetite-Cu skarns associated with epizonal granodiorite pluton of Cretaceous age. Reported reserves of 650,000 tons ore that grade 45.2 percent Fe, 0.75 percent Cu, 0.01 oz/ton Au, and 0.08 oz/ton Ag.

119 **Copper City** - Stratiform Cu-Zn-Ag-Au massive sulfide deposit hosted in late Precambrian Wales Group. Reported grades of up to 12.7 percent Cu, 2.7 percent Zn, 2.5 oz/ton Ag, and 0.2 oz/ton Au.

120 **Quartz Hill** - World-class porphyry-Mo deposit in composite felsic pluton (25 Ma. old); proven reserves of 1.5 billion tons ore that grade 0.136 percent Mo, including 490 million tons with grades of 0.219 percent MoS_2.

121 **Niblack** - Volcanogenic Cu-Pb-Au-Ag massive sulfide deposit hosted in Precambrian(?) Wales Group or Ordovician to Silurian Descon Formation; produced more than 1.4 million lb Cu, 11,000 oz Au, and 15,000 oz Ag.

122 **Bokan Mountain** - Numerous U-Th prospects associated with Jurassic peralkaline intrusive complex; from 1955 to 1971, produced more than 120,000 tons ore that graded about 1 percent U_3O_8. Also contains 40 million tons of 0.126 percent niobium and up to 1 percent REE metals.

123 **Kemuk Mountain** - Magmatic Fe-Ti deposit hosted in Cretaceous(?) pyroxenite. Inferred reserves of 2.4 billion tons that average 15 to 17 percent Fe, 2 to 3 percent TiO_2, and 0.16 percent P_2O_5.

124 **McLeod** - Porphyry Mo deposit that contains quartz-molybdenite fissure veins in quartz-feldspar porphyry. Chip samples contain up to 0.09 percent Mo.

125 **Johnson River** - Epigenetic(?) quartz-sulfide stockwork or massive sulfide deposit hosted in volcaniclastic, pyroclastic, and volcanic rocks of Jurassic Talkeetna Formation. Average grades of 9.4 to 24.8 percent Zn, 2.8 percent Pb, 1.7 percent Cu, and 0.6 to 1.2 oz/ton Au reported.

126 **Nimiuktuk River** - Small hill of massive, high-grade barite estimated to contain at least 1.5 million tons barite. Widespread stream-sediment Ba anomalies in area indicate further barite potential.

127 **Kensington** - Stockworks of quartz veins in sheared and chloritized quartz diorite produced 10,900 tons grading 0.18 oz/ton gold prior to 1930. Estimated to contain at least 7.5 million tons grading 0.14 oz/ton gold.

128 **Jualin** - Five quartz-fissure veins in Cretaceous quartz diorite, more than 15,000 ft of underground workings; produced 48,387 oz gold, mainly prior to 1930.

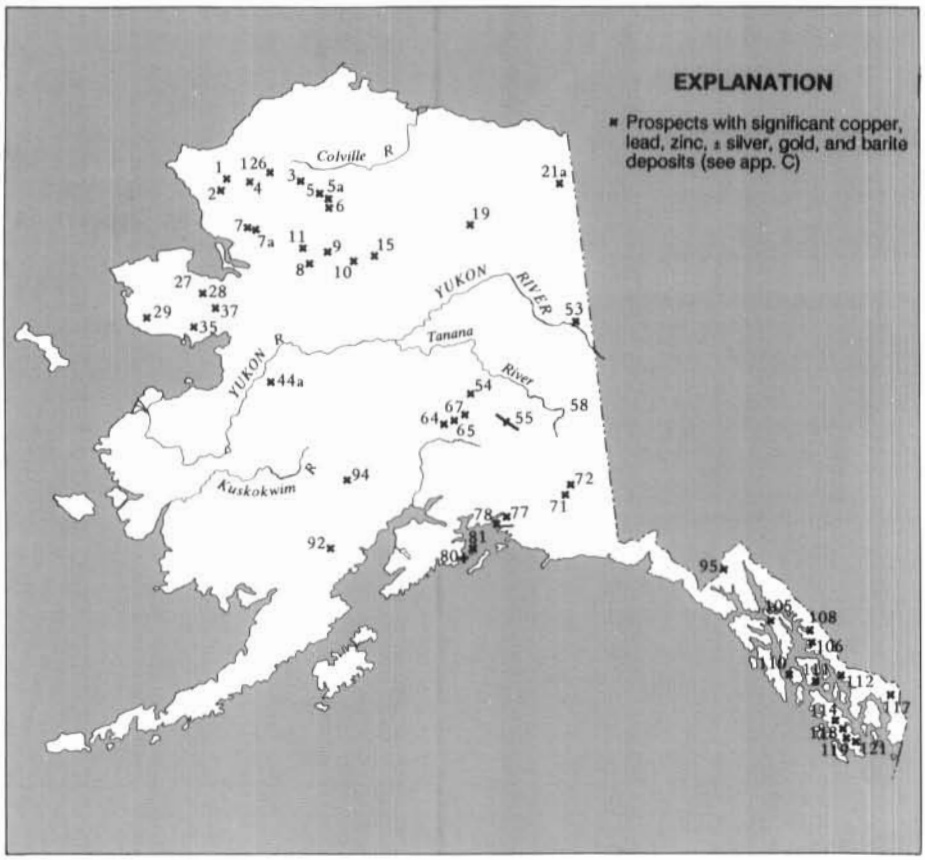


Figure 57. *Locations of significant copper, lead, zinc, ± silver, gold, and barite deposits in Alaska, 1989.*

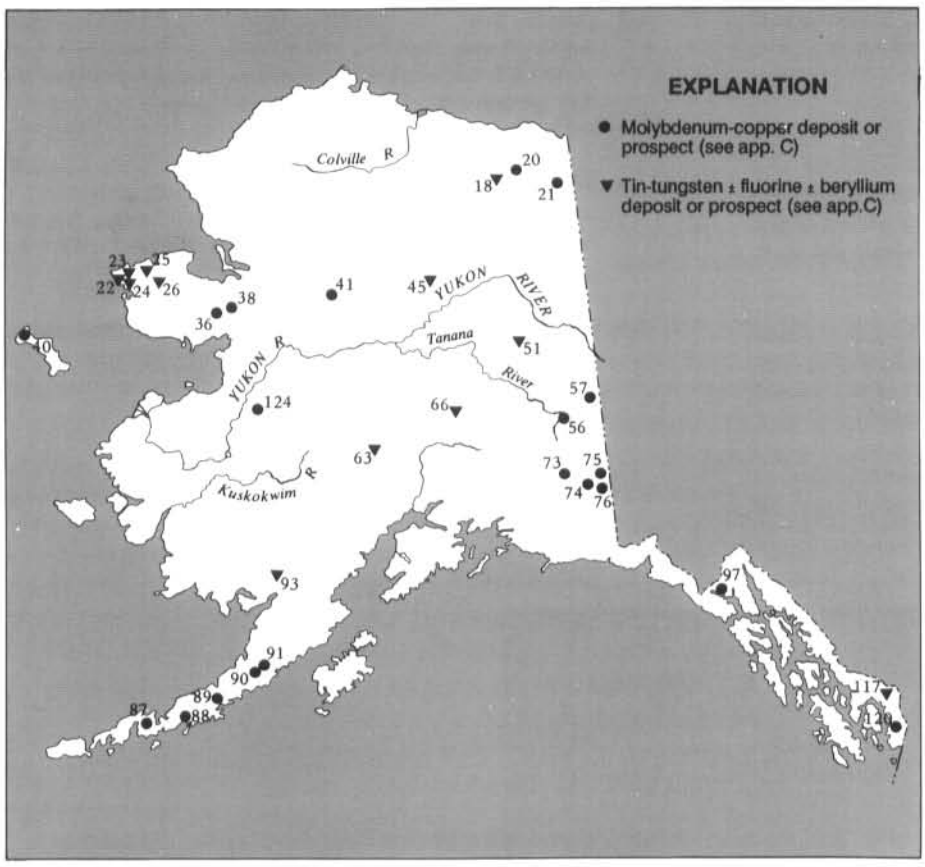


Figure 58. *Locations of significant molybdenum-copper, and tin-tungsten ± fluorite and beryllium deposits in Alaska, 1989.*

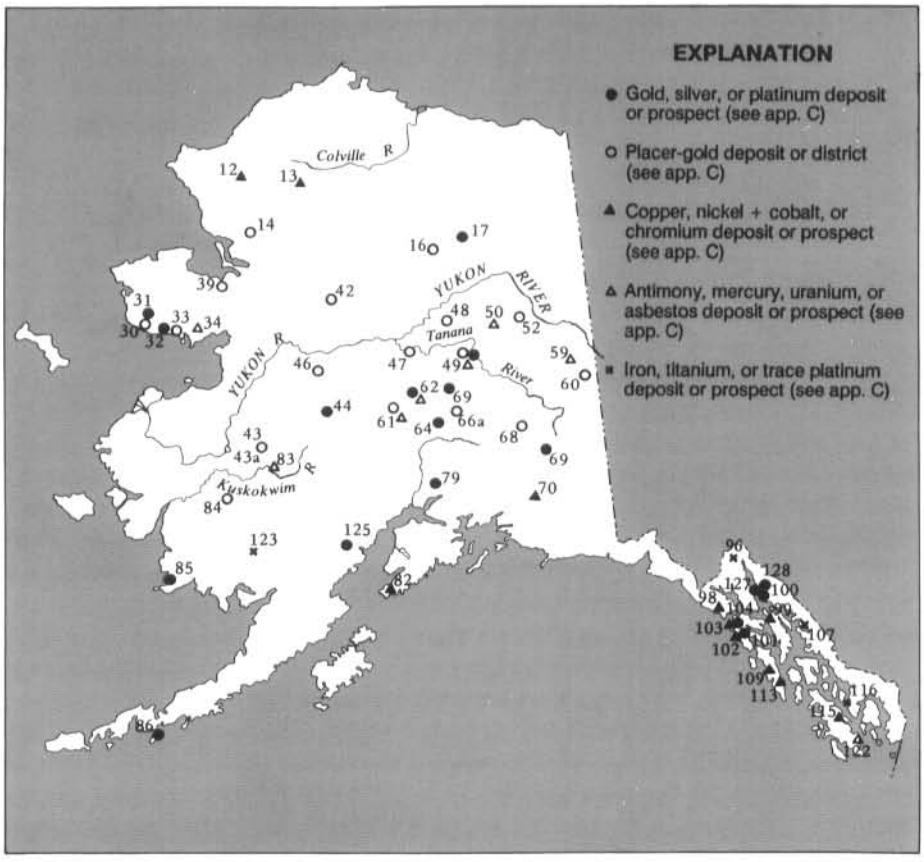


Figure 59. *Locations of significant gold, silver, platinum, and strategic mineral deposits in Alaska, 1989.*

APPENDIX D

Mining licenses issued by the Alaska Department of Revenue, 1989

AAA VALLEY GRAVEL
Box 872453
Wasilla, AK 99687
(sand and gravel)

AOS MINING AND ENGINEERING
Box 1170
Fairbanks, AK 99712

JIM ABBOTT/RODNEY BLAKESTAD
Box 20458
Denver, CO 30220

ROLAND E. ACHMAN
Box 61185
Fairbanks, AK 99706

DEL ACKELS (2)
Box 2151
Fairbanks, AK 99707

ALAMIN MINING CORPORATION
Box 215
McGrath, AK 99627

ALASKA AGGREGATE CORPORATION (4)
240 W. 68th Ave.
Anchorage, AK 99518
(sand and gravel)

ALASKA GOLD COMPANY (2)
Box 640
Nome, AK 99762

ALASKA HARDROCK, INC.
Box 1229
Palmer, AK 99645
(lode)

ALASKA LIME COMPANY
Box 196
Cantwell, AK 99729

ALASKA MINERALS
Thomas R. Hanna
2470 Engineers Cutoff
Juneau, AK 99801
(quartz)

ALASKA PLACER DEVELOPMENT INC. (2)
Box 81467
Fairbanks, AK 99708

ALASKA VENTURES
Morris Walters
746 Marine View Dr.
Longview, Washington 98632

ALBERT CREEK MINING
Calvin W. Hutcheson
Box 33
Eagle River, AK 99577

ALDER CREEK MINES
Patricia S. Franklin
1213 Coppet
Fairbanks, AK 99709

WILLIAM J. ALDRIDGE
Box 1334
Palmer, AK 99645

ALEUTIAN MATERIALS, INC.
Box 1188
Woodinville, WA 98072
(sand and gravel)

ALYESKA OIL & EXPLORATION
Glen Couch
Box 737
Tok, AK 99780

AMAX EXPLORATION, INC.
1707 Cole Blvd.
Golden, CO 80401

AMERICAN COPPER AND NICKEL CO.
2314 North Cherry Rd.
Spokane, WA 99216

ANCHOR EXCAVATION INC.
2405 South Cushman
Fairbanks, AK 99701

ANCHORAGE SAND & GRAVEL CO. INC.
1813 East First Ave.
Anchorage, AK 99501
(sand and gravel)

GERALD IRVIN ANDERSON
1013 E. Dimond Blvd.
Anchorage, AK 99515

WAYNE ANDERSON
1901 Cheechako Dr.
Fairbanks, AK 99709

ANDY MINING COMPANY
1017 E. Dimond Blvd., Box 362
Anchorage, AK 99515

ANNABELLE MINE
James G. Roland
710 McGrath Rd.
Fairbanks, AK 99712

ANVIL MINING, INC.
Noel S. Tanner
Box 1369
Nome, AK 99762

ASSOCIATED CONSTRUCTION
Joseph Rollins
Box 266
Anchor Point, AK 99556
(sand and gravel)

BOB AULT
Box 82330
Fairbanks, AK 99708

AURORA MINING
Lester Lines
Box 10-3820
Anchorage, AK 99510

CLYDE BALDWIN/BRANDT GONDALL
Box 8
Chicken, AK 99732

BALLATAR EXPLORATIONS LTD.
Carl Lalonde
Box 468
Sand Point, AK 99661

PAUL BARELKA
1215 9th Ave.
Fairbanks, AK 99701

KARL J. BASSETT (2)
Box 61652
Fairbanks, AK 99706

BATTLE MOUNTAIN EXPLORATION CO.
600 W. 58th Unit J
Anchorage, AK 99518

TOD BAUER
Box 871502
Wasilla, AK 99687

ALICE E. BAYLESS
Box 28
Chicken, AK 99732

BEAVER STATE MINING
Richard J. McCallum
Box 3138
Fairbanks, AK 99701

BEEHIVE MINING
Layne Gardner
872 Ridgetop Loop
North Pole, AK 99705

WILLIAM JOHN BEERMAN
2416 S. 1st St.
Yakima, WA 98901

EARL BEISTLINE
Box 80148
Fairbanks, AK 99708

BILL L. BELL
% Mike Shupe
1035 W. Northern Lights Blvd.
Anchorage, AK 99503

BERG-WETLESON
Rhinehart Berg
General Delivery
Candle, AK 99728

ARTHUR AND JEANNE BERGLUND
H.C.R. 1 Box 6275
Palmer, AK 99645

ROBERT H. BETTISWORTH
924 Kellum, #303
Fairbanks, AK 99701

CLARKE H. BILLINGS
Four Brothers Mining
Box 81117
Fairbanks, AK 99708

RUSSELL L. BIRDSELL
Box 1908
Cave Creek, AZ 85331

BLACK SANDS MINING CO.
Box 871478
Wasilla, AK 99687

BLACK VELVET MINING CO.
Roy Thomas George
1334 San Blanco Dr.
Salinas, CA 93901

KERRY BLAKE
Box 543
Nome, AK 99762

RODNEY BLAKESTAD
Box 84569
Fairbanks, AK 99708

PATRICK J. BLISS
711 H St., Ste. 450
Anchorage, AK 99501

ROBERT WAYNE BLONDEAU
Box 602
Valdez, AK 99686

BOULDER CREEK MINING
Les Fickes
Box 2618
Fairbanks, AK 99707

GLENN D. & LELA BOUTON
665 Farmers Loop Rd.
Fairbanks, AK 99712

CARL A. BRACALE, JR.
733 W. 4th Ave., #605
Anchorage, AK 99501

JOHN T. BRENNAN
Kehaulani Belfield
Box 74875
Fairbanks, AK 99707

DANIEL BROTHERTON
440 Old Richardson Hwy.
Fairbanks, AK 99701

BROWN & BROWN ENT.
Randy Brown
Box 2585
Palmer, AK 99645

OPAL BRUHN
Box 8022
Nikiski, AK 99635

T.L. BRYANT (2)
Mascot Mining Inc.
Box 264
Ridgway, CO 81432

GARY BUCHOLZ
2004 Old Steese N.
Fairbanks, AK 99712

NORMAN BUCY
Bucy Management II
3638 Dunkirk Ct.
Anchorage, AK 99502

BUGLI MINING AND EQUIPMENT
Box 21
Soldotna, AK 99669

JOHN R. BURNS
Box 5
Chicken, AK 99732

MICHAEL R. BUSBY
Kachemak Mining Corp.
47660 Falls Creek Dr.
Homer, AK 99603

ROBERT J. CACY, JR.
Box 106
Central, AK 99730

CAITHNESS ALASKA MINING CO.
2173 University Ave.
Fairbanks, AK 99709

CAMP CREEK MINING
General Delivery
Boundary, AK 99790

CANADA TUNGSTEN MINING CORP. LTD.
1600 - 1066 W. Hastings St.
Vancouver, BC, Canada V6E 3X1

CARLO & SONS MINING CO.
2113 Southern
Fairbanks, AK 99701

ROBERT D. CARLSON
17732-A James Way
Eagle River, AK 99577

CASWELL CREEK SAND & GRAVEL
Harold Bell
Box 147
Willow, AK 99688
(sand and gravel)

AL CEREPA
Box 1
Kenai, AK 99611

CHENA MINING CO.
Douglas M. Clark
8540 Williwas
Anchorage, AK 99504

CHICKAMAN MINING CO.
Box 66
Chicken, AK 99732

COLD CACHE MINING
695 Roberts Roost Rd.
Fairbanks, AK 99712

LYLE WAYNE COLLEDGE
Box 60478
Fairbanks, AK 99706

COMPASS MINING CO.
Box 2700
Fairbanks, AK 99707

COMINCO
Madelyn Millholland
139 E. 51st
Anchorage, AK 99503

COMINCO-ALASKA EXPLORATION (2)
Phil St. George
139 E. 51st Ave.
Anchorage, AK 99503

CONGDON CONSTRUCTION & MINING
925 Commerce St.
Fairbanks, AK 99701

JAMES P. CONWAY
H.C.R. 2, Box 7660
Palmer, AK 99645

JOHN COOK (2)
Box 393
Fairbanks, AK 99707

ROGER C. COPE
Box 75404
Fairbanks, AK 99707

R.L. CORBIN
6909 Timothy St.
Anchorage, AK 99502

FRED G. CORNELIUS
1615 Madison Dr.
Fairbanks, AK 99709-5533

THOMAS L. CORNWALL/ JUNE BAIRD
Box 80789
Fairbanks, AK 99708

FRANK ARTHUR COUCH
149 Farnsworth Blvd.
Soldotna, AK 99669

BRUCE COX
BC Consulting
Box 5901
Ketchikan, AK 99901

CRISWELL MINING & EXPLORATION
H.C.R. 80, Box 5998
Chugiak, AK 99567

BILL CROLEY
S.G. Olson
Box 191
Tok, AK 99789

CROOKED DOG MINING
Byron Henshaw
1210 W. 38th St.
Anchorage, AK 99503

JAMES W. CUDE
James W. Cude Mining
Box 876
Pleasanton, TX 78064

VERL DOUGLAS CUSHMAN, SR.
Rt. 3, Box 1
Blackfoot, ID 83221

DEBBIE DALE
D & K Mining
3104 Dyke Rd.
North Pole, AK 99705

JOHN DAVIS
H.C.R. 10, 77.5 Richardson Hwy.
Fairbanks, AK 99701

DELIMA PLACERS
Don Delima
Box 81467
Fairbanks, AK 99708

DEPEM
105 Dunbar Ave.
Fairbanks, AK 99701

JOHN T. DEWAN
Box 870257
Wasilla, AK 99687

DIBBLE CREEK ROCK
H.C.R. 67, Box 530
Anchor Point, AK 99556
(sand and gravel)

DICK CREEK MINING
Box 1673
Fairbanks, AK 99707

FRANK DIECKGRAEFF
Metco, Inc.
H.C.R. 64, Box 300
Seward, AK 99664
(sand and gravel)

ROY A. DIEHL (2)
5941 Arctic, Unit B
Anchorage, AK 99518

DOME CREEK MINING
General Delivery
Chicken, AK 99723

DUGGER MINING COMPANY
Mike Dugger
Box 94
Central, AK 99730

MICHAEL B. DUGGER
5218 Half Moon Dr.
Colorado Springs, CO 80915

RODERICK E. DUNN
Box 350
Talkeetna, AK 99676

RICHARD DUTHIE
230 Sunnyhill Dr.
Fairbanks, AK 99712

DAVE EBERHARDT
Smith Brothers Mining
551 Eberhardt Rd.
Fairbanks, AK 99712

ECHO BAY EXPLORATION, INC. (2)
4404 Thane Rd.
Juneau, AK 99801

EEP'S EQUIPMENT RENTALS AND MINING
Dog Street
Takotna, AK 99675

RONALD H. ENGSTROM
Engstrom Dredging Co.
Box 536
Nome, AK 99762

KRISTER ERIKSSON
Box 872809-199
Wasilla, AK 99687

EVECO
1818 Old Steese Hwy. N.
Fairbanks, AK 99712

DANIEL L. EVEN
Box 82092
Fairbanks, AK 99708

SHELL M. EWING
Rick Q. Williams
559 Knik Rd.
Wasilla, AK 99687

THOMAS E. FAA
Route 1
Mile Post 260 Parks Hwy.
Healy, AK 99743

FAIRVIEW MINING INC.
7920 King St.
Anchorage, AK 99518

GRAVEL FAIRWAY
Walter C. Wilcox
Box 2
Soldotna, AK 99669
(sand and gravel)

CRYSTAL FAGUNDES-BURNS
Box 5
Chicken, AK 99732

HERBERT F. FASSLER
Box 670181
Chugiak, AK 99567

HARRY, SR. & J.D. FAULKNER
Box 1307
Bethel, AK 99559

GARY FELDMANN
2011 Central Ave.
Fairbanks, AK 99701

FLAT CREEK MINING
Box 81464
Fairbanks, AK 99708

FLAT CREEK PLACERS
J.E. & R.S. Fullerton
Flat, AK 99584

FLAT PICK MINING
Gordon D. Fulton
Box 118
Central, AK 99730

CLARK FLEMING
Box 68
Chicken, AK 99732

FORTUNE MINING COMPANY OF ALASKA
Box 872172
Wasilla, AK 99687

FORTY-FIVE PUP MINING
Box 7
Chicken, AK 99732

PATRICIA SATHER FRANKLIN
1213 Coppet St.
Fairbanks, AK 99701

FREEDOM MINING & EXPLORATION
Roy L. Ruble
Box 80351
Fairbanks, AK 99708

CURTIS J. FREEMAN (17)
Fairbanks Exploration Inc.
Box 82549
Fairbanks, AK 99708

GHD RESOURCES PARTNERS LTD.
W.L. Shaffer
316 Rio Verde
El Paso, TX 79912

MARK GAEDE/GARY LINDMAN
Box 2192
Soldotna, AK 99669

DENNIS RAY GARRETT
6311 Debarr Rd., #243
Anchorage, AK 99504

TIMOTHY GEIERMANN
Box 92050
Anchorage, AK 99509

STANLEY M. GELVIN/ EDWIN C. GELVIN
Box 30149
Central, AK 99730

GERAGHTY MINING
405 Juneau St.
Fairbanks, AK 99701

DAVID L. GERKE
6901 Debarr, Ste. 2-B
Anchorage, AK 99504

GERMANICA INC.
Box 1285
Fairbanks, AK 99707

WAYNE EUGENE GIBSON
1610 Southern
Fairbanks, AK 99701

WILLIAM E. GIRARD
8801 Tempest Circle
Anchorage, AK 99507

CARL GLANVILLE
H.C.R. Box 1195
Anchor Point, AK 99556

GLENN EXPLORATION
308 Haines Ave.
Fairbanks, AK 99701

GOLD DIGGERS
3515 Industrial Ave.
Fairbanks, AK 99701

GOLD FOX
Ron Twogood
Box 60203
Fairbanks, AK 99706

GOLDEN FANTASY
Box 74124
Fairbanks, AK 99707

GOLDEN PLOVER MINING
Ray Bridges
Box 213
Gakona, AK 99586

GOLDEN SLIPPER II
237 Ina
Fairbanks, AK 99701

GOLDSTREAM EXPLORATION
John T. Larson
Box 80772
Fairbanks, AK 99708

RICHARD GOODSON (2)
Box 12
Chicken, AK 99732
HANK GRADNEY
Box 74400
Fairbanks, AK 99707

GRATEFUL DOG MINING CO. (3)
Roger B. McPherson
1563 Jones Rd.
Fairbanks, AK 99709

GORDON S. GREBE (2)
Box 116
Anchor Point, AK 99556

DOUGLAS GREEN
Green Mining & Exploration
Box 61455
Fairbanks, AK 99706

GREENS CREEK MINING CO.
H.M. Wimborne
3000 Vintage Blvd., #200
Juneau, AK 99801

SCOTT GREGER/JAMIN KLOPMAN
Box 101
Red Devil, AK 99656

GROUNDHOG MINING
Box 121
Central, AK 99730

EDWIN M. GROVER
6311 Debarr Rd., #203
Anchorage, AK 99504-1799

GYPSY LUCK MINE
624 Maple
Shelton, WA 98584

ALBERT M. HAGEN
RTM Company, Inc.
General Delivery
Manley Hot Springs, AK 99756

G.A. HANKS & SONS
Box 2533 Hwy. 16
W. Sacramento, CA 95691-2098

G.A. HANKS & SONS
% Ray Malesby
Box 381
Tok, AK 99780

R.A. HANSON CO. INC.
Box 7400
Spokane, WA 99207

HARD SHIP MINING COMPANY
Donald R. Gates
2501 Lake Otis Pkwy
Anchorage, AK 99508

JEFF HARRISON/L.W. EQUIPMENT
Box 80905
Fairbanks, AK 99708

HARRISON CREEK MINING
Box 61185
Fairbanks, AK 99706

BARNEY HARROD
1875 Arctic Loon Circle
Fairbanks, AK 99709

DONALD S. HART/DONALD R. KNIPE
General Delivery
Chicken, AK 99723

DONALD HART
Rt. 1, Box 189
Banks, OR 97106

MICHAEL GEORGE HARTMAN
Box 74921
Fairbanks, AK 99707

GEORGE R. HASKINS
Box 1777
Fairbanks, AK 99707

EDWIN L. HATCH
Box 1801
Nome, AK 99762

HAYDEN EXPLORATION AND MINING
Box 110930
Anchorage, AK 99511

MARK HEINZ
Box 268
Gakona, AK 99586

HEFLINGER MINING & EQUIPMENT CO.
665 10th Ave., #307
Fairbanks, AK 99701

HELEN WARNER MINING
Helen Warner
Box 80674
Fairbanks, AK 99708

GREGORY J. HELMS
Box 10673
Fairbanks, AK 99710

ROBERT J. HENDRICKS/ JAMES W. BELFIELD
Box 1934
Fairbanks, AK 99707

JACK HENDRICKSON
Box 10154
Fairbanks, AK 99710

MARTIN M. & JEAN A. HERZOG
14250 Sabine St.
Anchorage, AK 99516

DENNIS P. HIGGINS/ WALLY SIMMONS
925 Aurora Dr.
Fairbanks, AK 99709

DON HIGHAM
2175 Ogden
San Bernadino, CA 92405

RUSSELL D. HOFFMAN
Hoffman Mining
H.C.R. 60, Box 153
Copper Center, AK 99573

CARSON HOLT
General Delivery
Ester, AK 99725

HOMER & WILLIAM HOOGENDORN
Box 84
Nome, AK 99762

HOPE MINING CO.
Al P. Johnson
Box 101827
Anchorage, AK 99510

AL HOPEN
Box 74246
Fairbanks, AK 99707

INTERIOR ALASKANA ASSOCIATES
742 Bonnet Rd.
Fairbanks, AK 99712

J.A.B. DEVELOPMENT
4554 Homer Dr., #32
Anchorage, AK 99503

JACKSON CONSTRUCTION
241 Aspen
Soldotna, AK 99669
(sand and gravel)

JACKSON MINING CO.
Roy E. Traxler
936 Coppet St.
Fairbanks, AK 99709

DANIEL D. JENSEN (2)
Box 12
Delta Junction, AK 99737

O.J. JILES
5250 Auburn-Folsom Rd.
Loomis, CA 95650

BRIAN C. JOHNSON
Box 104
Central, AK 99730

MICHAEL R. JOHNSON
Myrtle Creek Mine, Inc.
Box 1192
Soldotna, AK 99669

THOMAS A. JOHNSON
Howard Fisher
720 M St., Ste. 200
Anchorage, AK 99501

TOMMY & MYRTLE JOHNSON
Box 608
Nome, AK 99762

K.C. MINING CO.
Kenneth C. Hanson
Box 10657
Fairbanks, AK 99710

K.L.K., INC.
H.C.R. 4, Box 9070
Palmer, AK 99645

KALMBACH, INC.
Box 872148
Wasilla, AK 99687
(earth)

ALBERT W. KANGAS
Box 1
Ruby, AK 99768

RICHARD D. KARR
Box 60782
Fairbanks, AK 99706

ROBERT & SUSAN KELLER
Box 113
Healy, AK 99743

KELLY MINING
Timothy J. Kelly
General Delivery
Manley, AK 99756

JOHN KLEMENCIC
7513 Gaviota
Van Nuys, CA 91406

CLIFF KNOWLTON
2207 John Evans Ln.
Fairbanks, AK 99712

RICHARD KNUDSON (2)
Box 210168
Anchorage, AK 99521

T.J. KOPPENBERG
H.C.R. 4, Box 9068
Palmer, AK 99645

LAWRENCE KORDECKI
300 Howland Rd., #3
Fairbanks, AK 99712

JOE MARK KRALL
Box 770050
Eagle River, AK 99577

KRISTI-PHYLEE MINING
Box 1656
Fairbanks, AK 99707

RUDY W. KRIZAK
4426 Churchill St.
Shoreview, MN 55126

BETTY WAGGONER KRUTZSCH
Box 2497
Del Mar, CA 92014

KURT'S CONSTRUCTION
Kurt A. Ueeck
1900 Granite View Dr.
Delta Junction, AK 99737
(sand and gravel)

L.B.M.B. MINING COMPANY
1536 W. Marinett Ave.
Exeter, CA 93221

LAC MINERALS (U.S.A.) INC.
Box 156, N. Tower Royal Bank Plaza
Toronto, Ont., Canada M5J2J4

R.J. LACOCK/R.J. COLZANI
11209 S. Des Moines Way
Seattle, WA 98168

NORM LAFRAMBOISE
11 Nightingale Dr.
North Bay, Ont., Canada P1A2R1

KATHRYN K. LAMAL (2)
Search Light Consultants
Box 81310
Fairbanks, AK 99708

HOWARD C. LAMBERT (2)
Box 87
Ester, AK 99725

JUANITA R. LARSON
9499 Brayton Dr., #116
Anchorage, AK 99507

STELLA D. LAVENDER
Box 91725
Anchorage, AK 99509

JAMES LENTINI
Box 1347
Valdez, AK 99686

TED HALE LEONARD/ CARL ROGER REDFERN
Box 51
Salcha, AK 99712

RAY LESTER
732 Old Steese Hwy., #8
Fairbanks, AK 99712

BILL & CLARA LIGHT
Box 74804
Fairbanks, AK 99707

DAVID LIKINS (3)
Box 106
Eagle, AK 99738

DAVID W. LIKINS/ LARRY R. TAYLOR
Box 101
Eagle, AK 99738

DAVID W. LIKINS/ NEIL THURNEAU
Box 106
Eagle, AK 99738

LILLIAN CREEK MINE, INC.
Ronald K. Tucker
Box 60334
Fairbanks, AK 99706

GEORGE & ELIZABETH LIVERMORE (2)
3302 Dorbrandt, #4
Anchorage, AK 99503

LONE SPRUCE MINING
George Strickler
16900 Ransom Ridge Rd.
Anchorage, AK 99516

LONESOME MINING CO.
Charles Timothy Jackson
S.R. Box 2893GG
Wasilla, AK 99687

STEVE MILAN LOSONSKY
Box 80321
Fairbanks, AK 99708

LOST RIVER MINING
Lenhart Grothe
Box 411
Nome, AK 99762

DICK LOUD
742 Bennett Rd.
Fairbanks, AK 99712

LINDON M. LOUDERMILK
10441 Loudermilk Circle
Anchorage, AK 99516

MITCHELL LOVELESS
Rolling Stone
6665 Richardson Hwy.
Salcha, AK 99714
(sand and gravel)

MARIN LOVS
2326 St. Elias Dr.
Anchorage, AK 99517

LYMAN RESOURCES IN ALASKA, INC.
Box 192
McGrath, AK 99627

MTM MINING
Box 80447
Fairbanks, AK 99708

JOHN E. McCLAIN
The Mining Co.
Box 436
Soldotna, AK 99669

RICHARD LEE McINTOSH
Box 61523
Fairbanks, AK 99706

JIMMY K. McMASTER-SCHNEIDER
Bushmaster Management Co.
Box 774407
Eagle River, AK 99577

HOWARD F. McWILLIAMS
Box 221603
Anchorage, AK 99522

MAGIC CIRCLE MINING
Stephen R. Weber
335 Slater Dr.
Fairbanks, AK 99701

MAGNUM MINING
Cyril & Larry Wood
Box 1789
Palmer, AK 99645

JOSEPH A. MALATESTA, SR.
Box 318
Clam Gluich, AK 99568

MANIA MINING
236 Farewell
Fairbanks, AK 99701

MANKOMEN EXPLORATION INC.
Box 20458
Denver, CO 80220

ALBERT & CECILIA MANNS
Paradise Valley
Bettles, AK 99726

NIKOLAJ MARCHUK
Box 89
Delta Junction, AK 99737

SANDRA MARK
914 Octavia
El Paso, TX 79902

MICK MARTINEK
H.C.R. 02, Box 7459
Palmer, AK 99645

CLEON MARTINSON
7204 227th Place S.W.
Mountlake Terrace, WA 98043

ELMER MARTINSON
Box 452
Nome, AK 99762

F.E. MASSENGALE
General Delivery
Chicken, AK 99732

PERRY MASSIE/BOB RUA
Box 3040
Fallbrook, CA 92028

DIANE ELIZABETH MATHISEN
2261 Belmont Dr.
Anchorage, AK 99517

MARK D. MATTER
Marvel Dome Mining Co.
Box 44
Aniak, AK 99557

BARBARA M. MAXWELL
Maxwell Mine & Exploration
3910 Loc Sault Ave.
Anchorage, AK 99516

LESLIE L. MAXWELL
Maxwell Mine & Exploration
3910 Loc Sault Ave.
Anchorage, AK 99516

MESPELT & ALMASY MINING CO.
Nixon Fork Mine
McGrath, AK 99627
(lode)

MIDNIGHT SUN MINING (2)
871 Faultline Ave.
North Pole, AK 99705

HERSHAL DEAN MILLER
Box 289 Mary Dole Court
Soldotna, AK 99669

THE MINING MANAGEMENT CORP.
Box 91725
Anchorage, AK 99509

ANDREW W. MISCOVICH
Box 1489
Fairbanks, AK 99707

MISCOVICH MINING CO.
Box 262
Galena, AK 99741

HAROLD MITCHELL
Ham Mining Co.
Rt. 1, Box 287
Baraga, MI 49908

FRANK MIZE
H.C.R. 2, Box 932
Soldotna, AK 99669

GEORGE A. MOERLEIN/ ALEX W. BOLT
7300 O'Malley
Anchorage, AK 99516

VINCENT C. MONZULLA
2920 Monzulla Ln.
Fairbanks, AK 99701

CLAUDE MORRIS
Lucky Creek Mine Ltd. Partnership
Box 547
Girdwood, AK 99587

DAVID J. MOSS
Box 681
Tok, AK 99780

LLOYD MOTHERSHEAD
Dutch Harbor Aggregate
Box 4543
Dutch Harbor, AK 99692
(sand and gravel)

MRAK PLACER MINE
Box 1963
Palmer, AK 99645

DONALD E. MULLIKIN (2)
Box 790
Homer, AK 99603

JACK V. MURPHY
Box 825
Valdez, AK 99686

ARNE W. MURTO
Box 850
Kasilof, AK 99610

NANA REGIONAL CORP. INC.
4706 Harding Dr.
Anchorage, AK 99517

JACK NEUBAUER
General Delivery
Manley Hot Springs, AK 99756

JAMES H. NORCROSS
Box 242
Willow, AK 99688

WILLIAM H. NORDEEN
Emma Creek
Coldfoot, AK 99701

ROGER NORDLUM
Box 171
Kotzebue, AK 99752

NORTH STAR INVESTMENT CO.
Box 157
Cantwell, AK 99729

NORTHERN BONANZA
Box 100971
Anchorage, AK 99510

VIRGIL NORTON
Box 84647
Fairbanks, AK 99708

NYAC MINING CO.
737 E Street
Anchorage, AK 99501

OLD YELLER MINING
Rt. 2, Box 67A
Elgin, OR 97827

ALAN G. OLSON/VICTOR E. LOYER
Box 165
Palmer, AK 99645

OSTLER GOLD MINE CO.
Dana Ostler
2021 Pembroke St.
Anchorage, AK 99504

OUTSIDER MINING CO.
John James Troutner
Box 909
Girdwood, AK 99587

P AND P MINE
2551 Peede Rd.
North Pole, AK 99705

P & S MINING CO.
Box 9072
Coldfood, AK 99701

CACY PATTON
Box 1505
Fairbanks, AK 99707

D.B. PARENT/M. DOZETTE/ D.A. YOUNG
1015 10th Ave.
Fairbanks, AK 99701

GLENN C. PARR
Gypsy Luck Mine
Rt. 1, Mile Post 260
Healy, AK 99743

PAUL AND COMPANY
Box 83102
Fairbanks, AK 99708

MAC PAYNE
1079 Victor
North Pole, AK 99705

DAVID PENZ
Box 29
Russian Mission, AK 99657

JOSEPH PETERSON
3600 Minnesota, Ste. D
Anchorage, AK 99503

BERT PETTIGREW
Box 1230
Nome, AK 99762

ROY PHILPOTT
115 Charles St.
Fairbanks, AK 99701

PLATTE MINING CO.
Dennis E. Wyatt
H.C.R. 3, Box 8100-L
Palmer, AK 99645

POLAR MINING INC. (2)
Dan or Don May
4545 Woodriver Dr.
Fairbanks, AK 99709

RALPH JAMES PORTER
Box 72
Soldotna, AK 99669

WILLARD B. POWERS (2)
4202 E. University Dr.
Phoenix, AZ 85034

PRINCE CREEK MINING CO.
Alvin H. Agoff
General Delivery
Flat, AK 99584

QUALITY SAND & GRAVEL
John I. Waters
Box 1456
Palmer, AK 99645
(sand and gravel)

QUARTZ CREEK EXPLORATION CO.
Box 242
Sterling, AK 99672

RB ROCK AND GRAVEL CO.
Box 49
Ester, AK 99725

RCL MINING
2108 Central Ave.
Fairbanks, AK 99701

RAINBOW MINING
Dennis Gilbreath
Box 10048
Fairbanks, AK 99710

DWAIN REDDEKOPP INC.
Box 210027
Auke Bay, AK 99821
(green stone and quartz)

RED FOX MINING
James Ashley Crabb
Box 10
Central, AK 99730

RICHARD REDMOND
Box 157
Girdwood, AK 99587

LEO A. REGNER
Box 2733
Fairbanks, AK 99707

PAUL RICE/DARYL RIAN
1077 Cube Ave.
North Pole, AK 99705

THOMAS W. RIDNER
Box 2555
Fairbanks, AK 99707

ELLEN E. ROBERTS
Roberts Mining
Box 82182
Fairbanks, AK 99708

MICHAEL D. ROBERTS
1303 O'Connors Rd., #32
Fairbanks, AK 99701

ROBERT ROBERTS
Box 225
Tok, AK 99780

VICKI ROBESON/FRANK KNAPP
Box 13148
Trapper Creek, AK 99683

ROCK PRODUCTS INC.
151 E. Herning, Ste. 205
Wasilla, AK 99687
(sand and gravel)

RON ROMAN
Box 1614
Fairbanks, AK 99707

JOHN ROOP
390 Carpenter
Wasilla, AK 99687

ROSANDER MINING
Ronald Rosander
Box 129
McGrath, AK 99627

JOHN D. RUBEL
8183 Richardson Hwy.
Salcha, AK 99714

RUSSELL MINING CO.
Gene Russell
Box 21
Central, AK 99730

TERRY LEE RUSSELL
Box 58417
Fairbanks, AK 99711

S & H ENTERPRISES
Rober Severson
H.C.R. Box 180
Deer River, MN 56636

SMK-2 MINING
Michael A. Sweetsir
Box 170
Ruby, AK 99768

SALTER & ASSOCIATES INC.
Box 30
Manley, AK 99756

SAVAGE MINING
Dwayne Savage
Box 10613
Fairbanks, AK 99710

BUDDY M. SAUNDERS
1939 Jack St.
Fairbanks, AK 99709

PAUL SAYER
Box 10
Homer, AK 99603

ROGER SAYER
Box 1684
Fairbanks, AK 99701

JOHN T. SCHNABEL
Box 149
Haines, AK 99827

WERNER SCHUSTER
H.C.R. 03, Box 8080
Palmer, AK 99645

DAVID HUGH SCOTT
3605 Arctic #1769
Anchorage, AK 99503

DAVID HUGH SCOTT
3605 Arctic, #1769
Anchorage, AK 99503

SEARCHLIGHT CONSULTANT INC.
505-744 W. Hastings St.
Vancouver, BC, Canada V6C1A5

SECOND VENTURE MINING CO.
D.E. Hansen/Leslie Arnett
502 McKinley View Dr.
Fairbanks, AK 99712

EVERETT A. SELMAN
1062 Pine Point Rd.
Republic, WA 99166

GEORGE W. SEUFFERT, JR. (2)
Box 156
Central, AK 99730

W.L. SHAFFER (2)
316 Rio Verde
El Paso, TX 79912

JOHN A. SHILLING (2)
Box 81424
Fairbanks, AK 99708

SHORT GULCH MINING CO. LTD.
Box 9
Ruby, AK 99768

JOHN SIPES
2741 Perimeter Dr.
North Pole, AK 99705

SKOOKUM MINING
Box 10139
Fairbanks, AK 99710

PAT J. SMITH
General Delivery
Central, AK 99730

WILLIAM L. SMITH
906 Cunningham
Anchorage, AK 99501

SNOW LION MINING CO. (2)
Jerry Lee Fabrizio
5042 18th Ave., NE
Seattle, WA 98105

SORENSEN BROTHERS
Box 30183
Central, AK 99730

HAROLD & BETTY SOULE
2840 E. 142nd Ave.
Anchorage, AK 99516

JAMES D. SOURANT
420 Oceanview Dr.
Anchorage, AK 99515

ROBERT L. SOUTHWOOD
Box 60782
Fairbanks, AK 99706

THERESA A. SPEAKER/
GEORGE A. MORRIS
1309 Helios Ave.
Fairbanks, AK 99709

SYLVIA SPENCER
984 Dennis Rd.
Fairbanks, AK 99711

SPHINX AMERICA INC. (2)
Box 81978
Fairbanks, AK 99708

SPRING CREEK SAND & GRAVEL
H.C.R. 78, Box 1155
Chugiak, AK 99567
(sand and gravel)

SPRUCE CREEK MINING
Ophir
McGrath, AK 99627

HELEN MARIE STAHL
5817 Winding Wy.
Anchorage, AK 99504

PAUL STEINHACKER
151 E. 71 St.
New York, NY 10021

STEPP A-LONG (2)
290 Pearl Dr.
Fairbanks, AK 99712

JACK J. STEWART
2420 Jack Warren Rd.
Delta Junction, AK 99737

MICHAEL STORMONT
828 Second Ave.
Fairbanks, AK 99701

WILLIAM C. STUDEBAKER
Lemons, Vetter, Studebaker
Box 342
Fairbanks, AK 99707

SUPER STAR MINING
Box 30032
Central, AK 99730

SUPER STOCK MINING
Box 30032
Central, AK 99730

JAMES SWAN
452 WINTER AVE.
Fairbanks, AK 99712

SWEEPSTAKES MINING
1112 Lakeview Terrace
Fairbanks, AK 99701

LLOYD D. SWENSON
1843 Bridgewater
Fairbanks, AK 99709

RICHARD SWENSON (2)
Box 16082
Two Rivers, AK 99718

WAYNE H. TACHICK (2)
Box 3503
Soldotna, AK 99669

A.J. TAYLOR
407 1/2 D St.
Fairbanks, AK 99701

TAYLOR'S & TAYLOR'S MINING CO.
Box 101
Eagle, AK 99738

TERRA COTTA EXPLORATION
S. Randolph Bailey
7031 Giggs Hill Circle
Anchorage, AK 99504
(lode)

KEVIN D. THOMPSON
Box 875534
Wasilla, AK 99687

THREE G MINE
Rt. I, Mile Post 260
Healy, AK 99743

THURMAN OIL & MINING (4)
Dennis Higgins
925 Aurora Dr.
Fairbanks, AK 99709

TIMBER CREEK MINING CO.
5914 Hwy 30 W.
The Dalles, OR 97058

CYNTHIA TOOHEY (3)
Box 113
Girdwood, AK 99587

ROBERT TOPOROWSKI
Cook Inlet Region, Inc.
3020 David Rd., Apt. D6
Fairbanks, AK 99709

TRANS ALAS-CAN GOLD &
MINERAL SURVEY CORP.
4159 Hood Ct.
Anchorage, AK 99517

TREASURE CREEK MINING (2)
Box 1638
Fairbanks, AK 99707-1638

TRI-CON MINING INC.
Box 83730
Fairbanks, AK 99708
(lode)

TRI VALLEY CONSTRUCTION
2001 Westwind Dr., #14
Bakersfield, CA 83301

JIM TUFTS
Broad Pass Mining Inc.
General Delivery
Cantwell, AK 99729

TUNGSTEN MINING CO.
John Charles Thomas
Box 9023
Coldfoot, AK 99701

OSCAR TWEITEN
Box 162
Fairbanks, AK 99707

DAVID & LESLIE UNDERWOOD
Box 53
Central, AK 99730

USIBELLI COAL MINE INC. (2)
Box 1000
Healy, AK 99743
(coal)

TOM C. VANOSTRAND
Box 314
Healy, AK 99743

D.B. VIAL & B.W. COMSTOCK
General Delivery
Candle, AK 99728

MICHAEL L. VIAL
Box 889
Candle, AK 99728

BETTY VIERSEN
Q-11 Enterprises
Box 22
Glennallen, AK 99588
(sand and gravel)

EARL VOYTILLA
Box 58211
Fairbanks, AK 99711

WGM INC.
Robert K. Rogers
Box 100059
Anchorage, AK 99510
(lode)

DARRELL WALKER
H.C.R. 56810 E. End Rd.
Homer, AK 99603

WALKER MINING (4)
11477 Miners Wy.
Rough & Ready, CA 95975

DANIEL P. WALSH
9641 Vangard Dr., #15
Anchorage, AK 99507

J.D. WALSH
Box 2095
Nome, AK 99762

ROSS EDWARD WALTER
1247 Hartzog Lp.
North Pole, AK 99705

GARY WAREHIME
333 Lakeshore Dr.
Anchorage, AK 99503

FRANK R. WARREN
Box 11
Central, AK 99730

JIM WATKINS
% Ron Mistler
Box 2871
Palmer, AK 99645

DOUGLAS L. WEATHERS
Box 8082
Nikiski, AK 99635

ANDREW G. WESCOTT
Little Eldorado Gold Camp
1132 Lakeview Terrace
Fairbanks, AK 99701

DAVID C. WHITE
200-535 Thurlow St.
Vancouver, BC, Canada V6E3L2

DOROTHY D. WILCOX
433 M St.
Anchorage, AK 99501

WILD RIVER VENTURES
General Delivery
Bettles, AK 99726

FRANK & VIVIAN WILLFORD
Box 10570
Fairbanks, AK 99710

WILBUR A. & ANN J. WILLIAMS
Flat, AK 99584

DAVID L. WILMARTH/MITCH WHALEY/LEROY DICKMANN
Box 111037
Anchorage, AK 99511

RICHARD WILMARTH
Red Devil, AK 99656

GEORGE R. WILSON
H.C.R. 03, Box 8360
Palmer, AK 99645

HELEN WILSON
8446 Bearberry St.
Anchorage, AK 99502

LAURA WILSON-SHEMEL
H.C.R. 31, Box 5187-A
Wasilla, AK 99687

WINDFALL GOLD MINING CORP.
Box 1929
Nome, AK 99762

WINGETTE INC.
Ross Novak
Box 83200
Fairbanks, AK 99708

KENNETH WISE
Box 212313
Anchorage, AK 99521

GORDON A. WOLD
525 W. Third Ave., Ste. 201
Anchorage, AK 99506

RAY D. WOLF
Ray Wolf Mining
Box 625
Cave Junction, OR 97523

ROBERT V. WOLFF
Boundary Via Tok, AK 99780

MORRIS WOLTERS
746 Marine View Dr.
Longview, WA 98632

JAMES LEE WOOD
Box 58597
Fairbanks, AK 99711

CHARLES B. WOODRUFF
Box 2278
Fairbanks, AK 99707

RON WREDE
2116 NE 80th
Seattle, WA 98115

WRIGHT'S AURORA CONSTRUCTION
Box 60515
Fairbanks, AK 99706
(sand and gravel)

LEWIS WYMAN
Chicken, AK 99732

L.E. & MARILYN A. WYRICK
Box 261
McGrath, AK 99627

GEORGE ROBERT YODER
1527 Henry St.
North Pole, AK 99705

ROBERT V. YOUNG
Box 211
Talkeetna, AK 99676

YUKON MINING CO. INC. (2)
Box 101454
Anchorage, AK 99510

YUTAN CONSTRUCTION CO.
Box 1775
Fairbanks, AK 99707
(sand and gravel)

LES PAUL ZERBE
356 Louise Lane
Fairbanks, AK 99709

GEORGE W. ZIMMER
Box 140174
Anchorage, AK 99514

JOSEPH D. ZIMMERMAN
Box 12
Manley Hot Springs, AK 99756

APPENDIX E
Primary metals production in Alaska, 1880-1989[a]

Year	Gold		Silver		Mercury		Antimony		Tin		Lead		Zinc		Platinum		Copper		Chromium	
	(oz)	(md)	(oz)	(td)	(flask[b])	(td)	(lb)	(td)	(lb)	(td)	(tons)	(td)	(tons)	(md)	(oz)	(td)	(lb)	(md)	(tons)	(td)
1880-1899	1,153,889	23.85	496,101	329.0	-	-	-	-	-	-	250	17.0	-	-	-	-	-	-	-	-
1900	395,030	8.17	73,300	45.5	-	-	-	-	-	-	40	3.4	-	-	-	-	-	-	-	-
1901	335,369	6.93	47,900	28.6	-	-	-	-	-	-	40	3.4	-	-	-	-	250,000	0.04	-	-
1902	400,709	8.28	92,000	48.5	-	-	-	-	30,000	8.0	30	2.5	-	-	-	-	360,000	0.04	-	-
1903	420,069	8.68	143,600	77.8	-	-	-	-	50,000	14.0	30	2.5	-	-	-	-	1,200,000	0.16	-	-
1904	443,115	9.16	198,700	114.9	-	-	-	-	28,000	8.0	30	2.5	-	-	-	-	2,043,586	0.28	-	-
1905	756,101	15.63	132,174	80.2	-	-	-	-	12,000	4.0	30	2.6	-	-	-	-	4,805,236	0.75	-	-
1906	1,066,030	22.04	203,500	136.4	-	-	-	-	68,000	38.6	30	3.4	-	-	-	-	5,871,811	1.13	-	-
1907	936,043	19.35	149,784	98.8	-	-	-	-	44,000	16.8	30	3.2	-	-	-	-	6,308,786	1.26	-	-
1908	933,290	19.29	135,672	71.9	-	-	-	-	50,000	15.2	40	3.4	-	-	-	-	4,585,362	0.61	-	-
1909	987,417	20.41	147,950	76.9	-	-	-	-	22,000	7.6	69	5.9	-	-	-	-	4,124,705	0.54	-	-
1910	780,131	16.13	157,850	85.2	-	-	-	-	20,000	8.3	75	6.6	-	-	-	-	4,241,689	0.54	-	-
1911	815,276	16.85	460,231	243.9	-	-	-	-	122,000	52.8	51	4.5	-	-	-	-	27,267,778	3.40	-	-
1912	829,436	17.14	515,186	316.8	-	-	-	-	260,000	119.6	45	4.1	-	-	-	-	29,230,491	4.82	-	-
1913	755,947	15.63	362,563	218.9	-	-	-	-	100,000[c]	44.1[c]	6	0.6	-	-	-	-	21,659,958	3.35	-	-
1914	762,596	15.76	394,805	218.3	-	-	-	-	208,000	66.6	28	1.3	-	-	-	-	21,450,628	2.85	-	-
1915	807,966	16.70	1,071,782	543.3	-	-	520,000	W	204,000	78.8	437	41.1	-	-	-	-	86,509,312	15.14	-	-
1916	834,068	17.24	1,379,171	907.4	-	-	1,200,000	W	278,000	121.0	820	113.2	-	-	8	0.7	119,654,839	29.50	-	-
1917	709,049	14.66	1,239,150	1,020.6	-	-	500,000	W	200,000	123.3	852	146.6	-	-	53	5.5	88,793,400	24.40	1,100	W
1918	458,641	9.48	847,789	847.8	-	-	540,000	W	136,000	118.0	564	80.1	-	-	284	36.6	69,224,951	17.10	1,100	W
1919	455,984	9.42	629,708	705.3	-	-	-	-	112,000	73.4	687	72.1	-	-	569	73.7	47,220,771	8.80	-	-
1920	404,683	8.37	953,546	1,039.7	-	-	-	-	32,000	16.1	875	140.0	-	-	1,478	160.1	70,435,363	13.00	-	-
1921	390,558	8.07	761,085	761.1	45	1.5	-	-	8,000	2.4	759	68.3	-	-	40	2.7	57,011,597	7.40	-	-
1922	359,057	7.42	729,945	729.9	-	-	-	-	2,800	0.9	377	41.5	-	-	29	2.8	77,967,819	10.50	-	-
1923	289,539	5.98	814,649	668.1	-	-	-	-	3,800	1.6	410	57.4	-	-	-	-	85,920,645	12.60	-	-
1924	304,072	6.29	669,641	448.6	2	0.3	-	-	14,000	7.1	631	100.9	-	-	28	2.6	74,074,207	9.70	-	-
1925	307,679	6.36	698,259	482.4	44	3.6	W	W	28,600	15.4	789	140.6	-	-	10	1.2	73,055,298	10.30	-	-
1926	324,450	6.70	605,190	377.0	22	1.7	W	W	16,000	10.4	778	124.4	-	-	3,570	274.5	67,778,000	9.49	-	-
1927	286,720	5.97	350,430	215.0	-	-	-	-	53,400	34.0	1,008	127.0	-	-	-	-	55,343,000	7.25	-	-
1928	331,140	6.85	351,730	187.0	-	-	-	-	82,000	41.0	1,019	118.0	-	-	120	9.0	41,421,000	5.96	-	-
1929	375,438	7.76	472,900	252.0	4	0.5	-	-	77,200	35.0	1,315	166.0	-	-	475	32.0	40,570,000	7.13	-	-
1930	408,983	8.47	408,570	157.3	-	-	-	-	29,400	9.3	1,365	136.5	-	-	-	-	32,651,000	4.24	-	-
1931	459,000	9.51	352,000	102.0	15	1.2	-	-	8,200	2.0	1,660	126.0	-	-	393	14.0	22,614,000	1.88	-	-
1932	493,860	10.20	234,050	66.0	8	0.5	-	-	-	-	1,260	75.6	-	-	-	-	8,738,500	0.55	-	-
1933	469,286	9.70	154,700	55.0	-	-	-	-	5,800	2.3	1,157	85.6	-	-	605	18.6	29,000	0.02	-	-
1934	537,281	8.78	154,700	100.0	-	-	-	-	8,200[c]	4.3	839	62.1	-	-	2,555	85.6	121,000	0.06	-	-
1935	469,495	16.43	286,600	206.0	-	-	-	-	98,800	49.8	815	65.2	-	-	8,685	259.6	15,056,000	1.25	-	-
1936	540,580	18.92	484,306	375.0	-	-	-	-	226,000	105.0	941	86.6	-	-	5,654	241.9	39,267,000	3.72	-	-
1937	627,940	21.98	494,340	382.0	-	-	962,000	147.6	372,000[c]	202.3[c]	823	97.1	-	-	9,823	313.4	36,007,000	4.74	-	-
1938	662,000	23.17	479,853	310.0	8	0.6	444,000	54.8	210,000	89.1	994	91.5	-	-	41,000	2,460.0	29,760,000	2.98	-	-
1939	676,780	23.68	201,054	136.5	-	-	210,000	25.9	66,000	38.0	937	88.1	-	-	33,900	2,034.0	278,500	0.04	-	-
1940	755,900	26.45	191,679	136.3	156[c]	130.9	306,000	42.8	92,000	52.0	840	72.0	-	-	28,886	1,093.0	110,000	0.02	-	-
1941	692,314	24.23	199,700	142.0	W	W	774,000	87.3	93,600[c]	61.0[c]	742	58.0	-	-	22,630	813.0	144,000	0.02	-	-
1942	487,657	17.07	135,200	96.0	W	W	316,000	41.0	5,600	2.5	523	44.0	-	-	22,000	779.0	48,000	0.01	-	-
1943	99,583	3.49	31,700	22.0	786	153.4	368,000	33.3	2,000[c]	1.0[c]	200	22.0	-	-	27,900	1,020.0	54,000	0.01	5,564	186.3
1944	49,296	1.73	15,240	10.8	841	165.0	70,080	30.0	-	-	44	5.8	-	-	33,616	2,017.0	4,000	0.01	1,845	64.6
1945	68,117	2.38	9,983	6.2	275	180.0	W	W	-	-	11	1.8	-	-	22,949	1,377.0	10,000	0.01	-	-
1946	226,781	7.93	41,793	26.3	699	68.7	W	W	-	-	115	25.0	-	-	22,882	1,418.7	4,000	0.01	-	-
1947	279,988	9.79	66,150	46.3	127	10.6	52,000	16.1	2,000	2.2	255	76.5	226	0.15	13,512	1,351.2	24,000	0.06	-	-
1948	248,395	8.69	67,341	58.7	108	7.8	88,000	29.3	10,000	10.8	317	88.9	226	0.15	13,741	1,209.2	28,000	0.07	-	-
1949	229,416	8.03	36,056	32.4	102	7.9	88,000	31.3	114,000	100.8	49	11.2	226	0.15	17,169	1,545.2	7,700	0.02	-	-
1950	289,285	10.13	52,638	48.0	W	W	W	W	158,000	170.3	144	27.5	-	-	W	W	12,000	0.03	-	-
1951	239,628	8.38	32,870	29.8	28	W	1,718,000	2,061.6	138,000	198.0	21	7.2	-	-	W	W	2,000	0.01	-	-
1952	240,571	8.42	31,825	28.7	40	W	740,000	1,406.0	180,000	243.9	1	0.3	-	-	W	W	-	-	W	W
1953	253,771	8.88	35,387	32.1	1,023	270.0	W	W	98,000	105.9	-	-	-	-	W	W	-	-	W	W

APPENDIX E—Continued

Year	Gold (oz)	Gold (md)	Silver (oz)	Silver (td)	Mercury (flask[b])	Mercury (td)	Antimony (lb)	Antimony (td)	Tin (lb)	Tin (td)	Lead (tons)	Lead (td)	Zinc (tons)	Zinc (md)	Platinum (oz)	Platinum (td)	Copper (lb)	Copper (md)	Chromium (tons)	Chromium (td)
1954	248,511	8.70	33,694	31.8	1,046	276.0	-	-	398,000	409.9	-	-	-	-	W	W	8,000	0.02	2.953	208.0
1955	249,294	8.73	33,693	30.4	43	12.0	-	-	172,000	182.5	1	0.3	-	-	W	W	2,000	0.01	7,082	625.3
1956	204,300	7.33	26,700	24.1	3,414	837.0	134,400	150.0	-	-	1	0.3	-	-	W	W	-	-	7,200	711.5
1957	215,467	7.54	28,862	26.0	5,461	1,349.0	71,120	80.0	-	-	9	3.0	-	-	W	W	-	-	4,207	431.0
1958	186,000	6.53	24,000	22.0	3,380	774.0	-	-	-	-	-	-	-	-	W	W	10,000	0.03	-	-
1959	171,000	5.99	22,000	20.0	3,750	852.0	-	-	-	-	-	-	-	-	W	W	72,000	0.04	-	-
1960	180,000	6.30	23,000	21.0	4,450	938.0	W	W	-	-	-	-	-	-	W	W	82,000	0.04	-	-
1961	114,228	3.99	-	-	4,080	816.0	-	-	-	-	-	-	-	-	W	W	184,000	0.06	-	-
1962	165,142	5.78	-	-	3,843	711.0	-	-	-	-	-	-	-	-	W	W	-	-	-	-
1963	99,000	3.48	6,100	9.0	400	76.0	W	W	-	-	5	1.1	-	-	W	W	-	-	-	-
1964	58,000	2.05	7,200	6.0	303	95.0	46,400	60.3	-	-	-	-	-	-	W	W	22,000	0.01	-	-
1965	43,000	1.51	5,000	6.0	180	104.0	46,400	60.3	-	-	14	4.0	-	-	W	W	64,000	0.03	-	-
1966	27,325	0.96	7,000	9.0	185	101.0	16,000	19.2	-	-	19	4.3	-	-	W	W	-	-	-	-
1967	22,948	0.80	6,000	9.0	161	79.0	20,000	22.0	-	-	-	-	-	-	W	W	W	W	-	-
1968	21,000	0.81	3,000	6.5	156	78.0	6,000	6.0	-	-	-	-	-	-	W	W	-	-	-	-
1969	21,227	0.88	2,000	4.2	238	100.0	94,000	100.0	-	-	2	0.5	-	-	W	W	-	-	-	-
1970	38,400	1.38	4,000	7.0	3,100	1,260.0	365,000	410.0	-	-	-	-	-	-	W	W	W	W	-	-
1971	34,000	1.36	2,000	4.0	675	285.0	68,000	74.0	34,000	47.0	-	-	-	-	W	W	-	-	-	-
1972	8,639[c]	0.56	1,000	2.0	125	44.0	160,000	185.0	W	W	-	-	-	-	W	W	-	-	-	-
1973	15,000[c]	1.86	13,200	22.0	70	52.5	420,000	515.0	10,000	12.0	6	2.0	-	-	W	W	-	-	-	-
1974	16,000[c]	2.56	1,500	3.5	70	52.5	80,000	95.0	W	W	-	-	-	-	W	W	-	-	-	-
1975	14,980[c]	3.35	6,000	25.0	-	-	120,000	145.0	22,000	60.0	-	-	-	-	W	W	-	-	-	-
1976	22,887[c]	6.90	6,500	24.0	-	-	160,000	165.0	W	W	14	6.0	-	-	W	W	-	-	8,000[c]	1,200.0[c]
1977	50,000	7.80	8,000	20.0	-	-	W	W	W	W	-	-	-	-	-	-	-	-	-	-
1978	60,000[c]	12.00	6,000	50.0	-	-	W	W	W	W	-	-	-	-	-	-	-	-	-	-
1979	65,000[c]	18.00	6,500	93.0	-	-	100,000	125.0	100,000	830.0	-	-	-	-	-	-	-	-	-	-
1980	75,000[c]	32.00	7,500	111.0	-	-	-	-	120,000	984.0	31	29.0	-	-	-	-	-	-	-	-
1981	134,200[c]	55.20	13,420	111.3	W	W	-	-	106,000	700.0	-	-	-	-	900	200.0	-	-	-	-
1982	175,000[c]	69.90	22,000	198.0	-	-	-	-	198,000	1,365.0	-	-	-	-	W	W	-	-	-	-
1983	169,000[c]	67.60	33,200	332.0	-	-	22,400	45.0	215,000	1,100.0	-	-	-	-	W	W	-	-	-	-
1984	175,000[c]	62.13	20,000	159.0	5	1.5	135,000	225.8	225,000	400.0	-	-	-	-	W	W	-	-	-	-
1985	190,000	61.18	28,500	171.0	27	10.0	65,000	98.0	300,000	650.0	-	-	-	-	-	-	-	-	-	-
1986	160,000[c]	60.80	24,000	134.4	12	2.8	45,000	67.5	340,000	890.0	-	-	-	-	W	W	-	-	-	-
1987	229,707	104.51	54,300	391.0	NR	NR	-	-	288,000	460.0	-	-	-	-	W	W	-	-	-	-
1988	265,500	112.84	47,790	282.0	W	W	-	-	300,000	950.0	-	-	-	-	25	13.8	-	-	-	-
1989	284,617	108.7	5,211,591	27,300.0	NR	NR	NR	NR	194,000	672.0	9,585	7,700.0	19,843	29,400.0	-	-	-	-	-	-
Other[d]	-	-	-	-	1,438	-	-	-	-	-	-	-	-	-	333,936	46,940.3	-	-	-	-
TOTAL (metric)	32,124,771 (999,215 kg)	1,539.02	25,229,276 (784,736 kg)	43,647.4	40,945 (1,411,521 kg)	9,910.5	11,070,800 (5,021,714 kg)	6,655.1	7,201,400 (3,266,555 kg)	12,244.9	35,885 (32,555 tonnes)	10,709.1	20,521 (18,616 tonnes)	29,400.4	668,522[e] (20,793 kg)	65,805.9	1,373,793,932 (623,152 tonnes)	228.04	39,051 (35,427 tonnes)	3,426.7

[a]References from T.K. Bundtzen, DGGS, Fairbanks.
[b]76-lb flask.
[c]When state and federal figures differ significantly, state figures are used.
[d]Not traceable by year.
[e]Crude platinum; total production of refined metal is about 575,000 oz.
W = Withheld.
- = Not reported.
td = Thousand dollars.
md = Million dollars.

APPENDIX F

Production of industrial minerals, coal, and other commodities in Alaska, 1880-1989[a]

Year	Coal (s. tons)	Coal (md)	Sand and gravel (s. tons)	Sand and gravel (md)	Building stone[b] (s. tons)	Building stone[b] (md)	Barite (s. tons)	Barite (td)	Other[c] (dollars)
1880-1899	19,429[d]	0.14[d]	-	-	7,510	0.04	-	-	-
1900	1,200[d]	0.02[d]	-	-	510	0.01	-	-	-
1901	1,300[d]	0.02[d]	-	-	700	0.01	-	-	500
1902	2,212[d]	0.02[d]	-	-	800	0.01	-	-	255
1903	1,447	0.01	-	-	920	0.01	-	-	389
1904	1,694	0.01	-	-	1,080	0.02	-	-	2,710
1905	3,774	0.02	-	-	970	0.02	-	-	740
1906	5,541	0.02	-	-	2,863	0.03	-	-	19,965
1907	10,139	0.05		-	3,899	0.03	-	-	54,512
1908	3,107[d]	0.01[d]	-	-	2,176	0.03	-	-	81,305
1909	2,800	0.02	-	-	1,400	0.01	-	-	86,027
1910	1,000[d]	0.01[d]	-	-	W	W	-	-	96,408
1911	900[d]	0.01[d]	-	-	W	W	-	-	145,739
1912	355[d]	0.01[d]	-	-	W	W	-	-	165,342
1913	2,300	0.01	-	-	W	W	-	-	286,277
1914	1,190	0.01	-	-	W	W	-	-	199,767
1915	1,400	0.03	-	-	W	W	-	-	205,061
1916	12,676	0.05	-	-	W	W	-	-	326,731
1917	54,275	0.27	-	-	W	W	-	-	203,971
1918	75,816	0.41	-	-	W	W	-	-	171,452
1919	60,894	0.35	-	-	50,014	0.29	-	-	214,040
1920	61,111	0.36	-	-	37,044	0.27	-	-	372,599
1921	76,817	0.49	-	-	59,229	0.31	-	-	235,438
1922	79,275	0.43	-	-	54,251	0.30	-	-	266,296
1923	119,826	0.76	-	-	83,586	0.41	-	-	229,486
1924	99,663	0.56	-	-	35,294	0.26	-	-	348,728
1925	82,868	0.40	-	-	32,193	0.19	-	-	454,207
1926	87,300	0.46	-	-	33,283	0.20	-	-	423,000
1927	104,300	0.55	-	-	41,424	0.22	-	-	-
1928	126,100	0.66	-	-	63,347	0.31	-	-	-
1929	100,600	0.53	-	-	54,766	0.26	-	-	194,000
1930	120,100	0.63	-	-	66,234	0.33	-	-	157,300
1931	105,900	0.56	-	-	59,175	0.29	-	-	108,000
1932	102,700	0.53	-	-	54,167	0.27	-	-	223,400
1933	96,200	0.48	-	-	56,291	0.28	-	-	-
1934	107,500	0.45	-	-	64,234	0.36	-	-	46,155
1935	119,425	0.50	-	-	74,049	0.38	-	-	46,755
1936	136,593	0.57	-	-	76,379	0.38	-	-	45,807
1937	131,600	0.55	-	-	50,057	0.25	-	-	147,048
1938	159,230	0.62	-	-	189,090	0.21	-	-	125,302
1939	143,549	0.60	42,332	0.02	-	-	-	-	-
1940	170,174	0.88	515,011	0.10	-	-	-	-	-
1941	241,250	0.97	530,997	0.09	-	-	-	-	1,367,000
1942	246,600	0.99	W	W	-	-	-	-	1,124,000
1943	289,232	1.84	W	W	-	-	-	-	-
1944	352,000	2.37	712,496	0.50	-	-	-	-	2,350,309
1945	297,644	1.87	W	W	-	-	-	-	5,910,704
1946	368,000	2.36	W	W	-	-	-	-	2,005,241
1947	361,220	2.55	W	W	219,000	1.00	-	-	5,927,319
1948	407,906	2.79	W	W	67,341	0.33	-	-	1,257,699
1949	455,000	3.60	W	W	W	W	-	-	7,181,886

Year	Coal (s. tons)	Coal (md)	Sand and gravel (s. tons)	Sand and gravel (md)	Building stone[b] (s. tons)	Building stone[b] (md)	Barite (s. tons)	Barite (td)	Other[c] (dollars)
1950	421,455	3.03	3,050,020	2.38	W	W	-	-	2,100,000
1951	494,333	3.77	6,818,000	3.54	W	W	-	-	3,600,000
1952	648,000	5.77	6,817,800	3.54	W	W	-	-	9,052,000
1953	861,471	8.45	7,689,014	5.08	47,086	0.17	-	-	1,231,350
1954	666,618	6.44	6,639,638	6.30	283,734	0.47	-	-	1,572,150
1955	639,696	5.76	9,739,214	8.24	265,740	0.29	-	-	1,552,427
1956	697,730	6.37	9,100,000	8.30	50,000	0.02	-	-	1,551,500
1957	842,338	7.30	6,096,000	8.79	528,000	1.95	-	-	2,751,000
1958	759,000	6.93	4,255,000	3.87	615,000	2.07	-	-	695,000
1959	602,000[d]	5.88[d]	5,600,000	5.10	54,000	0.20	-	-	1,338,000
1960	669,000[d]	5.95[d]	5,892,000	5.35	80,000	0.30	-	-	975,000
1961	650,000[d]	5.87[d]	5,241,000	4.19	-	-	-	-	-
1962	675,000[d]	6.41[d]	5,731,000	5.36	-	-	-	-	-
1963	853,000	5.91	16,926,000	22.01	W	W	W	W	2,589,000
1964	745,000	5.01	26,089,000	18.49	W	W	W	W	4,912,000
1965	860,000[d]	5.88[d]	29,959,000	33.93	W	W	W	W	5,296,000
1966	927,000	6.95	17,457,000	21.79	W	W	44,000	350.0	6,167,000
1967	930,000	7.18	22,300,000	26.25	W	W	W	W	4,924,000
1968	812,000[d]	5.03[d]	17,515,000	20.73	W	W	91,000	W	4,117,000
1969	728,000[d]	4.65[d]	16,205,000	18.62	1,954,000	3.90	90,000	850.0	5,163,000
1970	786,000[d]	5.28[d]	20,375,000[d]	26.07[d]	6,470,000	10.01	134,000[d]	1,875.0	7,994,000
1971	748,000[d]	5.05[d]	26,391,000	41.99	2,658,000	5.07	102,000[d]	1,075.0	-
1972	720,000[d]	6.26[d]	14,187,000	15.21	652,000	3.01	W	W	-
1973	700,000[d]	6.23[d]	19,350,000	19.01	5,967,000	12.00	112,000	1,792.0	12,846,000
1974	700,000	7.34	118,740,000[d]	240.94[d]	5,484,000	12.95	110,000	1,895.0	14,495,000
			42,614,000	88.96					
1975	766,000	7.81	48,145,000	95.78	8,877,000	26.65	2,000[d]	30.0	12,731,000
1976	705,000	8.00	74,208,000[d]	204.73[d]	6,727,000	20.09	W	W	14,019,000
1977	780,000[d]	12.00[d]	66,126,000	134.25	4,008,000	17.47	-	-	14,486,000
1978	750,000	15.00	51,100,000	122.00	3,437,000	14.65	22,000	750.0	-
1979	750,000	16.00	50,900,000	104.90	3,650,000	15.45	20,000	800.0	930,000
1980	800,000	16.00	40,000,000	86.00	3,700,000	15.40	50,000	2,000.0	97,500
1981	800,000	17.60	46,000,000	88.20	4,200,000	19.30	-	-	256,000
1982	830,000	18.00	45,000,000	91.00	3,400,000	15.60	-	-	150,000
1983	830,000	18.00	50,000,000	105.00	5,270,000	25.00	-	-	242,000
1984	849,161	23.75	27,000,000	95.00	2,700,000	16.00	-	-	875,875
1985	1,370,000	39.73	28,184,080	112.06	2,500,000	12.00	-	-	559,000
1986	1,492,707	40.10	20,873,110	75.76	4,200,000	20.32	-	-	384,800
1987	1,508,927	42.35	16,696,374	42.66	1,805,000	11.62	-	-	388,400
1988	1,551,162	44.30	17,264,500	48.75	3,600,000	24.65	-	-	389,000
1989	1,452,353	41.46	14,418,000	39.88	2,914,000	20.34	--	--	1,492,000
Other[e]	-	-	-	-	2,300,000[f]	W	79,000	W	-
TOTAL	38,984,083	541.21	1,025,878,584	2,021.76	89,939,836	333.28	856,000	11,417.0	174,730,872
(metric)	(35,366,360 tonnes)		(930,471,875 tonnes)		(81,593,419 tonnes)		(776,563 tonnes)		

[a]Production histories for most commodities are summarized in Bundtzen (1982), Bundtzen and Smith (1982), and Bundtzen and others (1982).

[b]Building-stone production figures for 1880-1937 are for the southcentral and interior regions of Alaska only.

[c]Includes 2.4 million lb U_3O_8 (1955-71); 505,000 tons gypsum (1905-26); 286,000 lb WO_3 (intermittently 1916-80); 94,000 lb asbestos (1942-44); 540,000 lb graphite (1917-18; and 1942-50); and undistributed amounts of zinc, jade, peat, clay, soapstone, miscellaneous gemstones, and other commodities (1880--1985).

[d]When state (territorial) and federal figures differ significantly, state figures are used. Figures for sand-and-gravel production in 1974 show state estimates (118,740,000 s. tons; 240.94 md) and federal (42,614,000 s. tons; 88.96 md). The federal estimate was not added to total production.

[e]Production not traceable by year.

[f]Marble quarried on Prince of Wales Island, southeastern Alaska (1900-41).

W = Withheld.

- = Not reported.

td = Thousand dollars.

md = Million dollars.

Back cover: *Upper left--Auriferous pay surface on bedrock at Pit A-6 of the Denali mine, Valdez Creek Mining Company, in southcentral Alaska. Photo by J.T. Kline.*

Middle left--Consulting geolgist John Mitchell (deceased) and Josh Moore pour a gold-silver bullion bar at the Democrat lode, Richardson district near Fairbanks. Photo courtesy of Tri-Valley Mining Company.

Upper right--Experimental placer drill rig in operation offshore of Nome in State of Alaska waters. Photo by Mark Branston, courtesy of Westgold Inc.

Bottom--Inside Red Dog mill complex, northwest Alaska. Photo by Myron Wright, courtesy of Cominco-Alaska Inc.