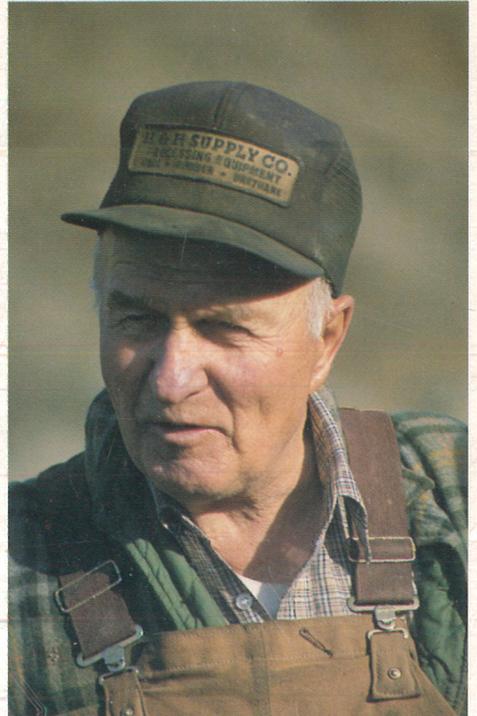
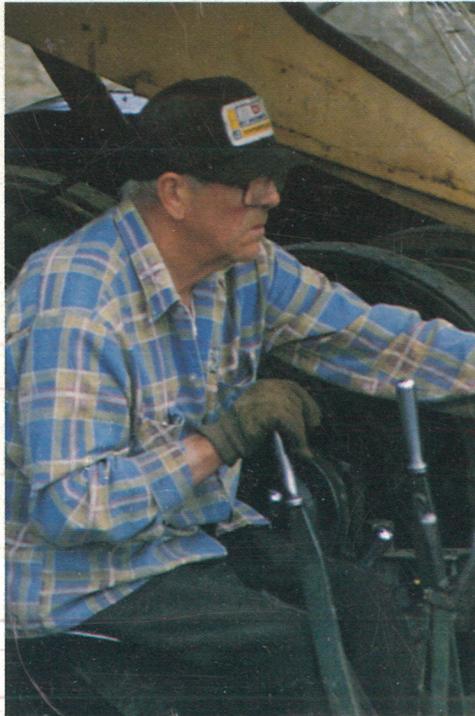


Division of  
Business Development  
Division of Geological &  
Geophysical Surveys  
Division of Mining



# ALASKA'S MINERAL INDUSTRY 1988

SPECIAL REPORT 43



Front cover: *Top--A backhoe feeds a mobile washing plant at Jack Neubauer's placer mine in the Fairbanks mining district. The washing plant was one of six 'dryland dredges' designed by the Carrington Company of Fairbanks, constructed by the Washington Iron Works of Seattle, and shipped to Alaska in the late 1930s.*

*Bottom center--Placer miner Carl Heflinger, shown operating his dragline, has mined in the Livengood area since 1958 with the help of his wife, Dorothy, and children, Fred, Dave, Bruce, and Mary. After coming to Alaska in 1932, Carl's first mine employment was hand mining an open cut with wheelbarrow and shovel for Helmar Johnson on Cleary Creek near Fairbanks, after which Carl operated a drift mine with his brothers on a tributary of nearby Fish Creek.*

*Bottom left--Richard Ott manages a large open-pit placer mine for Sphinx America Inc. on Fairbanks Creek northeast of Fairbanks. Richard is the grandson of Adolph Ott, who came over the Chilkoot Pass in 1897 and mined on Hunter Creek in the Rampart district, and the son of Martin Ott, who mines in the Eureka-Manley area.*

*Bottom right--Placer miner Jack Neubauer, with his wife Mary and son Greg, have mined in the Candle, Chandalar, Hot Springs, and Fairbanks mining districts since the 1950s. Jack came to Alaska in 1933 and first worked at the historic Kennecott copper mine in McCarthy before working for Finnish placer miner Gus Utilla in Ophir, Alaska.*

*All front cover photographs by C.B. Green, 1988.*

# ALASKA'S MINERAL INDUSTRY, 1988

By C.B. Green, T.K. Bundtzen, R.J. Peterson, A.F. Seward, J.R. Deagen, and J.E. Burton

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DIVISION OF GEOLOGICAL AND GEOPHYSICAL SURVEYS

SPECIAL REPORT 43



STATE OF ALASKA  
Steve Cowper, Governor

Fairbanks, Alaska  
1989

STATE OF ALASKA

DEPARTMENT OF COMMERCE AND ECONOMIC DEVELOPMENT

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Division of Business Development

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DEPARTMENT OF NATURAL RESOURCES

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Division of Geological and Geophysical Surveys

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Available from Alaska Division of Geological and Geophysical Surveys, 3700 Airport Way, Fairbanks, AK 99709 or 400 Willoughby Ave. (3rd floor), Juneau, AK 99801; and U.S. Geological Survey Public Information Office, 701 C St., Anchorage, AK 99513, or Information Specialist, 4230 University Drive, Anchorage, AK 99508. Also available from Division of Business Development, 1001 Noble St., Ste. 360, Fairbanks, AK 99701 or State Office Building (9th floor), Juneau. Mail orders should be addressed to the DGGGS office in Fairbanks.

## FOREWORD

*Special Report 43, 'Alaska's Mineral Industry - 1988,' is the eighth annual report produced by the Department of Commerce and Economic Development Division of Business Development and the Department of Natural Resources Division of Geological and Geophysical Surveys and Division of Mining.*

*The primary objective of this report is to provide current, accurate 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 projects and activities.*

*In 1988, the sum of expenditures for exploration and development, and the value of mineral production totaled \$552.6 million, an increase of 74 percent from 1987. This dramatic increase was primarily due to peak construction activities at the Red Dog and Greens Creek mines. However, significant increases in production and exploration also contributed; gold production increased from 229,700 oz in 1987 to 265,500 oz in 1988, and exploration expenditures nearly tripled from \$15.7 million in 1987 to \$45.5 million in 1988.*

*With production from the Greens Creek mine, beginning in 1989, and from the Red Dog mine, beginning in 1990, Alaska will become an international supplier of zinc, silver, and lead. Mineral exploration projects in several regions of Alaska will advance to the feasibility stage in 1989, and hold the potential for significantly increasing hard-rock gold and coal production in the early 1990s.*

*An expanding Alaska mineral industry will provide increased employment, income and revenue, and create new economic opportunities in all regions of the state.*



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



*Tom Lawson  
Acting Director  
Division of Business Development*



*Gerald L. Gallagher  
Director  
Division of Mining*

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# ALASKA'S MINERAL INDUSTRY, 1988

By C.B. Green,<sup>1</sup> T.K. Bundtzen,<sup>2</sup> R.J. Peterson,<sup>3</sup> A.F. Seward,<sup>4</sup> J.R. Deagen,<sup>5</sup> and J.E. Burton<sup>6</sup>

## SUMMARY

### INTRODUCTION

Alaska's mineral industry expanded dramatically in 1988. Significant increases occurred both in value of mineral production and in exploration and development expenditures (fig. 1, table 1). Exploration expenditures nearly tripled from \$15.7 million in 1987 to \$45.5 million in 1988. The Greens Creek and Red Dog mines each carried out peak construction activities during the year, which more than doubled development expenditures, from \$100.3 million in 1987 to \$275 million in 1988. Total production value increased 15 percent in 1988 to \$232.2 million, led by a 16-percent increase in gold production (from 229,700 oz in 1987 to 265,500 oz in 1988) and a modest recovery in the building-stone and sand-and-gravel industries.

The total value of Alaska's mineral industry in 1988, measured by the sum of exploration and development expenditures and production values, increased 74 percent from \$318.4 million in 1987 to \$552.6 million in 1988.

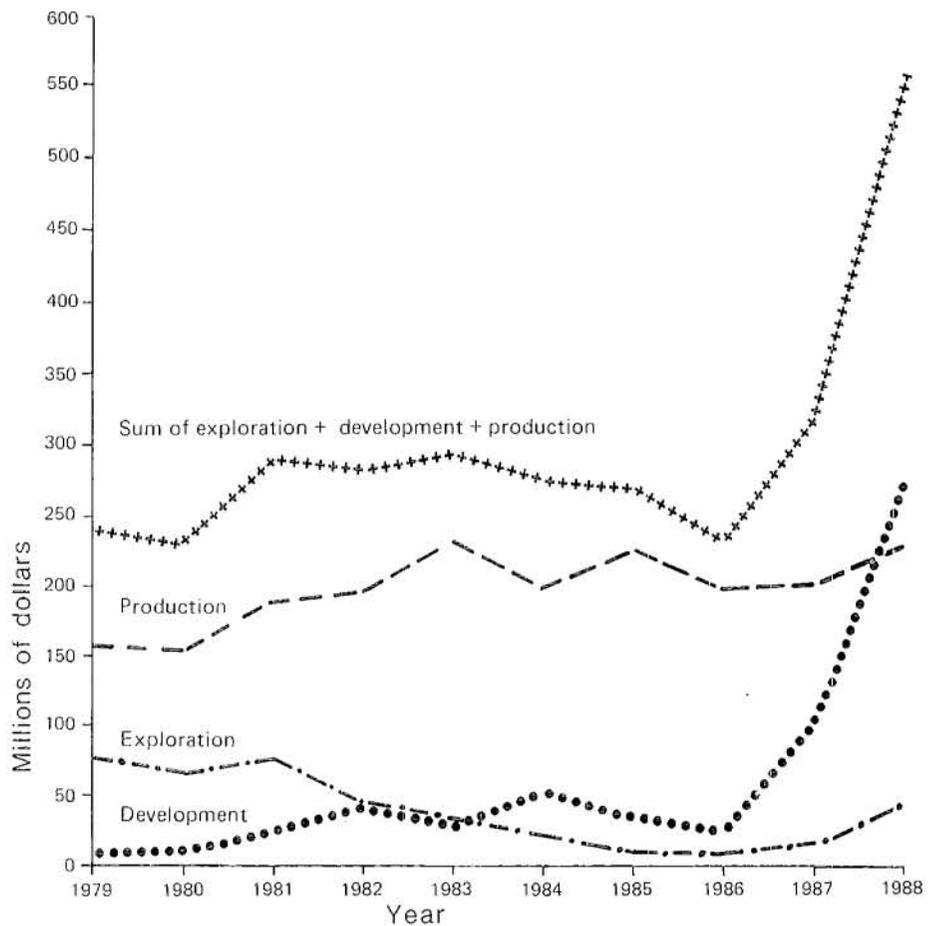


Figure 1. Value of total mineral activity in Alaska, 1979-88.

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<sup>6</sup>Applied Mining Technology Program, SCCE-UAF, Geist Road, Fairbanks, AK 99709.

Table 1. Total value of mineral industry in Alaska, 1986-88

	1986	1987	1988
Exploration	\$ 8,920,000	\$ 15,740,000	\$ 45,468,800
Development	24,331,972	100,250,848	274,945,400
Production	<u>198,461,007</u>	<u>202,389,898</u>	<u>232,172,000</u>
TOTAL	\$231,712,979	\$318,380,746	\$552,586,200

## MINERAL INDUSTRY EMPLOYMENT

The mineral industry employed 4,353 in 1988 compared to 3,299 in 1987, an increase of 32 percent. Mechanized gold mining--both placer and lode--and mineral development each accounted for 30 percent of the total employment followed by sand and gravel (17 percent), recreational mining and assessment work (8 percent), mineral exploration (6 percent), building stone (5 percent), coal mining (3 percent), and tin, soapstone and jade mining (1 percent). Construction at the Red Dog and Greens Creek mines and expanded exploration work statewide comprised over one-third of the total employment figure.

Table 2 summarizes mineral industry employment in 1988. The figures for coal and lode mining largely represent year-round employment. The other production sector figures represent a combination of seasonal and year-round employment. Figures for the mineral and exploration sectors are converted from reported and estimated seasonal and year-round employment into full-time employment equivalents. For the specific purpose of estimating total employment in Alaska created by the mining industry, general construction employment for mine-roads and facilities has been included in the development sector figures. However, it should be noted that other agencies, such as the Alaska Department of Labor, do not classify this construction employment as mining employment.

## PRODUCTION

Gold production again led other mineral commodities and accounted for 49 percent of total dollar value. An estimated 265,500 oz of gold were produced and valued at \$112.8 million. This represents an increase of 16 percent by quantity and 8 percent by value over 1987. USIBELLI COAL MINE, INC., shipped a record 810,862 tons of

Table 2. *Mineral industry employment in Alaska, 1988<sup>a</sup>*

Industry sector	Employment
Mineral production	
Precious metals	
Placer	1,206
Lode	99
Recreation	350
Sand and gravel	752
Building stone	210
Coal	122
Tin, jade, soapstone	40
Mineral development	1,294
Mineral exploration	280
<b>TOTAL</b>	<b>4,353</b>

<sup>a</sup>See text for discussion of this table.

coal to the KOREAN ELECTRIC POWER COMPANY, shipped 13,467 tons to Japan for testing, and produced 726,833 tons to fuel six interior Alaska power plants. Coal production in 1988 was 1.55 million tons, for an estimated value of \$44.3 million--about the same as in 1987. Sand and gravel production was 17.2 million tons, worth \$48.8 million--again about the same as in 1987. Approximately 3.6 million tons of building stone worth \$24.7 million were produced in 1988, up nearly 112 percent by value from 1987. Infrastructure development at the Red Dog mine, the Bradley Lake hydroelectric project, and at several mine sites in southeastern Alaska were responsible for increased building stone use. Gold, coal, building stone, and sand and gravel accounted for 99 percent of the total value of Alaska mineral production in 1988. Tin, silver, tungsten, jade, platinum, soapstone, and peat accounted for the remaining 1 percent.

The rise in 1988 gold production reflected greater output from several of the largest placer operations and from two interior hard-rock lode mines. The VALDEZ CREEK MINING COMPANY placer operation east of Cantwell produced 44,494 oz of refined gold (52,961 oz raw gold) and was Alaska's largest gold producer in 1988. Approximately 200 small gold

placer operations produced at levels similar to 1987. CITIGOLD ALASKA, INC. and TRICON MINING, INC., produced 21,395 oz of gold-silver bullion from lode deposits on Ester Dome near Fairbanks.

## DEVELOPMENT

Both the Greens Creek and Red Dog mine projects engaged in peak construction activities during 1988. An estimated \$269 million were spent in 1988 for the construction of roads, port, mine, mill and camp facilities at those mine sites.

The Greens Creek mine, on Admiralty Island near Juneau, began production in early 1989 and, at full capacity, is designed to produce 85,000 tons of concentrate annually, containing an estimated 6.4 million oz of silver, 36,000 oz of gold, 24,800 tons of zinc, and 9,000 tons of lead. The mine is the first major lode producer in Alaska in over four decades. The joint venture project is operated by the GREENS CREEK MINING COMPANY, a subsidiary of BP MINERALS AMERICA. The joint venture partners include BP MINERALS AMERICA (53.1 percent), HELCA MINING (28 percent), CSX OIL AND GAS CORPORATION (12.6 percent), and EXALAS RESOURCES (6.3 percent). When fully operational, Greens Creek will fill over 200 year-round positions with workers living in the Juneau area and commuting daily to the mine on a specially constructed catamaran ferry.

Construction activities in 1988 brought the Red Dog project, located 90 miles north of Kotzebue in the De Long Mountains, to 60-percent completion. The Red Dog deposit is owned by the NANA REGIONAL CORPORATION and operated by COMINCO ALASKA INCORPORATED. During 1988, the 52-mile road from the port site near Kivalina to the mine site was completed. At the port site, construction of the concentrate storage building, fuel tanks, and ship loading facilities was

undertaken. At the mine site, the camp accommodations and mine services buildings were constructed, the foundation for the concentrator mill prepared, and earthwork done at the main pit and tailings impoundment dam. During 1988, an estimated 1,000 people were employed on the construction of the road, port, and mine site. Start-up of the mine is scheduled for early 1990, with the first concentrate shipments to be made during that summer. At full capacity, the mine will produce 580,000 ton/yr of zinc concentrate, 120,000 ton/yr of lead concentrate, and 50,000 ton/yr of combined zinc-lead concentrate suitable for feed to an Imperial smelter furnace.

## EXPLORATION

Exploration activities in Alaska increased significantly in 1988, with expenditures totaling \$45.5 million, nearly tripling 1987 expenditures. Reported exploration employment increased 149 percent to a total of 2,802 person-months, from 1,126 person-months in 1987. As in recent years, the primary focus of exploration programs was precious metals. Over 90 percent of all expenditures were for precious metal exploration, with 6 percent for coal and 3 percent for base metal exploration. Over 70 percent of total exploration expenditures made in Alaska in 1988 were either raised through Canadian venture capital markets, or were from the cash flows of Canadian mining companies or their U.S. subsidiaries.

Southeastern Alaska was the most active region in the state in terms of exploration expenditures and employment. Over \$20 million was spent and 1,200 person-months of employment reported, representing 45 percent of statewide exploration expenditures. Several southeastern exploration projects advanced to the point where feasibility studies, and preliminary environmental baseline and permitting activities, will be

undertaken in 1989. These include the AJ Mine and Kensington Mine projects operated by ECHO BAY MINES and the Jualin Mine project operated by CURATOR AMERICAN. Other notable lode gold projects with significant exploration drilling programs in the region were carried out by LAC MINERALS, NEWMONT GOLD, and FMC GOLD. While much additional exploration activity is focusing on the reexamination of historical mines and properties in the region, grass-roots exploration efforts resulted in significant new mineral discoveries in 1988.

All other regions of the state also experienced significant increases in exploration activity. Notable projects with major exploration drilling programs on lode gold deposits were carried out by PLACER DOME U.S. INC., SOLOMON GOLD, and BHP UTAH INTERNATIONAL near Nome in the western region; by TRICON MINING, NERCO MINERALS, AMERICAN COPPER & NICKEL, and BP MINERALS in the eastern interior region; by BATTLE MOUNTAIN EXPLORATION CO. and COMINCO ALASKA EXPLORATION in the southwestern region; by GOLDEN ZONE RESOURCES, COMINCO ALASKA EXPLORATION, AMAX EXPLORATION, and HUNT, WARE & PROFFETT in the southcentral region; and by BATTLE MOUNTAIN and ASHTON MINING in the Alaska Peninsula region.

In coal exploration, IDEMITSU ALASKA INCORPORATED (IDEMITSU) carried out a major program on its state leases in the Matanuska coalfield near Palmer. In June 1988, IDEMITSU announced that UNION PACIFIC RESOURCES, its partner in the project, had withdrawn. IDEMITSU acquired UNION PACIFIC's interest, and, under a preliminary project schedule, could complete project permitting in 1990 and begin export in 1991 of up to 1.1 million ton/yr of bituminous coal to Japan.

## GOVERNMENT ACTIONS

Several significant legal or governmental actions affecting Alaska's mineral industry took place in 1988. The U.S. Supreme Court declined to hear the State of Alaska's appeal of the Alaska Supreme Court's interpretation of section 6(i) of the Alaska Statehood Act. As a result, the 1989 Alaska legislature will be amending certain state laws governing the location of state mining claims, and addressing the implementation of rental and royalty fees on state-owned lands.

The Alaska Department of Environmental Conservation adopted new mixing zone water quality regulations in 1988 that may help placer miners and other industrial water users comply with the state's turbidity standards. Guidelines are being developed to allow the new regulations to be tested in 1989 and implemented in the 1990 season. The U.S. Environmental Protection Agency issued effluent guidelines for placer mining, which will go into effect in 1989 and will require 100-percent recycling of mine process waters for the placer mining industry.

In federal actions, the U.S. Bureau of Land Management (BLM) completed draft environmental impact statements (EIS's) on the cumulative effects of placer mining on four interior Alaska river drainages. In late 1988, the first of the final EIS's to be issued identified a preferred alternative that proposed allowing placer mining to continue under management policies adopted in 1987. As part of the federal court order that mandated the preparation of the EIS's, an injunction was granted against the operation of placer mines disturbing more than five acres. Records of decision by the Secretary of the Interior on the EIS's are expected in early 1989; however, the lifting of the injunction will be at the discretion of the federal courts. In a similar action, the National Park Service will issue court-ordered EIS's on mining in Alaska's national parks,

where all mining has been indefinitely halted since 1985.

In late 1987, the U.S. Minerals Management Service took steps to hold a lease sale for the mining of gold and other minerals on submerged federal lands in Norton Sound. The proposed federal lease tracts are

located adjacent to state offshore leases where WESTGOLD is presently operating an offshore bucketline dredge. The draft EIS for the lease sale was completed in November 1988, and the preferred alternative identified 178,282 acres of outer continental shelf lands for leas-

ing. The final EIS is expected to be complete in May 1989. If a decision is made to proceed with the sale, a notice would be published in October 1989, with the lease sale scheduled for spring 1990.

## ACKNOWLEDGMENTS

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## EXPLORATION ACTIVITY DURING 1988

### INTRODUCTION

Mineral exploration expenditures in Alaska during 1988 nearly tripled from 1987 levels. Total reported exploration expenditures during 1988 were \$45.5 million, compared to \$15.7 million in 1987. Expenditures are listed by commodity and region in tables 3 and 4 and shown graphically in figure 2. Table 5 shows historical expenditures by region from 1981 to

1988. Over 70 percent of total exploration expenditures made in Alaska in 1988 were either raised through Canadian venture capital markets, or were from the cash flows of Canadian mining companies or their U.S. subsidiaries.

The total number of new claims filed in Alaska increased 43 percent from 8,276 in 1987 to 11,848 in 1988,

and the number of active claims for which assessment work was filed increased 11 percent, from 68,348 in 1987 to 75,542 in 1988 (figs. 3 and 4).

As in 1987, exploration focused largely on precious metals; over 90 percent of all reported expenditures were for gold, silver and platinum-group metals. For the most part, the companies with major exploration

Table 3. Reported exploration expenditures in Alaska by commodity groupings, 1982-88

	1982	1983	1984	1985	1986	1987	1988
Base metals	\$31,757,900	\$ 9,758,760	\$ 4,720,596	\$2,397,600	\$1,847,660	\$ 2,523,350	\$ 1,208,000
Precious metals	10,944,100	20,897,555	14,948,554	6,482,400	6,107,084	11,743,711	41,370,600
Industrial minerals	--	2,068,300	270,000	--	170,000	286,000	160,200
Coal and peat	2,900,000	1,338,454	2,065,000	270,000	790,000	1,150,000	2,730,000
Other	15,300	70,000	279,500	--	--	31,000	--
TOTAL	\$45,617,300	\$34,133,069	\$22,283,650	\$9,150,000	\$8,914,744	\$15,734,061	\$45,468,800

-- = No expenditures reported.

Table 4. Reported exploration expenditures in Alaska by commodity and region, 1988

	Northern	Western	Eastern interior	Southwestern	Southcentral	Alaska Peninsula	Southeastern
Base metals	\$585,000	\$ --	\$ 73,000	\$ --	\$ 115,000	\$ --	\$ 435,000
Precious metals							
Placer	178,000	666,500	220,100	9,000	973,300	--	30,000
Lode	230,000	3,215,000	5,896,200	2,626,000	5,488,000	1,797,000	20,041,500
Coal and peat	--	--	120,000	--	2,610,000	--	--
Industrial gems	--	--	25,000	200	--	--	135,000
<b>TOTAL</b>	<b>\$993,000</b>	<b>\$3,881,500</b>	<b>\$6,334,300</b>	<b>\$ 2,635,000</b>	<b>\$9,186,500</b>	<b>\$1,797,000</b>	<b>\$20,641,500</b>
Employment							
(person-days)	2,558	6,805	12,391	3,755	20,340	2,209	35,987
(months)	85	227	413	125	678	74	1,200

-- = No expenditures reported.

programs in 1988 had also been active in 1986 and 1987. The increase in expenditures results from high-cost advanced exploration activities such as road-building, underground tunneling, and intensive drilling programs, and reflects the success of grassroots exploration projects and prospect examinations initiated over the last two to three years. Discussion of statewide mineral activity is divided into regional divisions shown in figure 5, and locations of selected exploration projects are shown on figure 6.

### NORTHERN REGION

The northern region covers one-third of the state and includes some of Alaska's most remote terranes within the Brooks Range and on the North

Slope. Reported 1988 exploration expenditures in the northern region were \$0.99 million, an increase of 60 percent over 1987. Companies conducting exploration in the region reported 47 persons were employed a total of 85 person-months, or the equivalent of 7 full-time jobs.

### METALS

The NANA REGIONAL CORP. carried out reconnaissance exploration on their land selections in the Noatak area (loc. 1, fig. 6) and evaluated jade and gold deposits on claims near Kobuk purchased in 1988 from Stewart Properties. COMINCO ALASKA EXPLORATION drilled claims in the Noatak district west of the Red Dog property and worked on the Sun and

Smucker prospects in the Ambler mining district (loc. 1 and 2, fig. 6). In the Koyukuk (Wiseman) mining district, REGINALD KAKOVICH spent 18 days digging test holes on placer claims on Bear and Eagle Creeks, tributaries of the South Fork of the Koyukuk River; ALMINCO INC. conducted mapping, geochemical sampling, and drilling on the company's Eldorado claim group near the Hammond River; and BTW MINING & EXPLORATION CORP. sampled and mapped precious-metal deposits. PARADISE VALLEY MINING tested placer and lode claims at the company's properties in the Central Brooks Range. PARADISE VALLEY also operated a conventional placer mining operation and hosted tourists and recreational miners

Table 5. Reported Alaska exploration expenditures by region, 1981-88 (in millions of dollars)

	1981	1982	1983	1984	1985	1986	1987	1988
Northern	\$ 4.50	\$14.93	\$ 2.52	\$ 2.56	\$1.86	\$0.60	\$ 0.62	\$ 0.99
Western	2.03	5.55	3.77	4.94	0.65	0.58	1.18	3.88
Eastern interior	21.66	9.48	9.17	3.21	1.75	2.38	3.34	6.33
Southwestern	8.70	3.81	1.32	1.02	0.12	0.18	0.61	2.63
Southcentral	18.45	6.14	5.08	6.49	1.28	2.41	3.43	9.19
Alaska Peninsula	5.83	2.40	7.73	1.01	0.96	0.02	0.71	1.80
Southeastern	20.94	1.52	1.95	2.87	2.53	2.75	5.85	20.64
Unspecified		1.79	2.50	0.19				
<b>TOTAL</b>	<b>\$76.30</b>	<b>\$45.62</b>	<b>\$34.04</b>	<b>\$22.29</b>	<b>\$9.15</b>	<b>\$8.92</b>	<b>\$15.74</b>	<b>\$45.47</b>

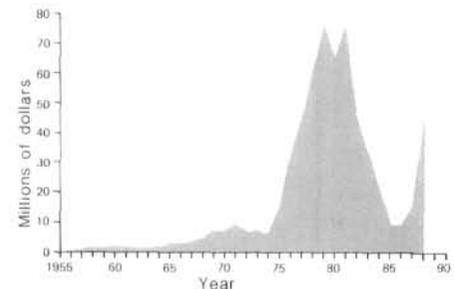


Figure 2. Mineral exploration expenditures in Alaska, 1955-88.

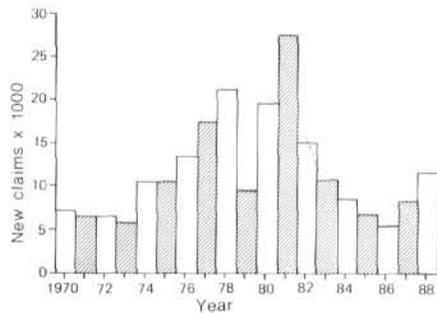


Figure 3. New claims filed in Alaska, 1970-88.

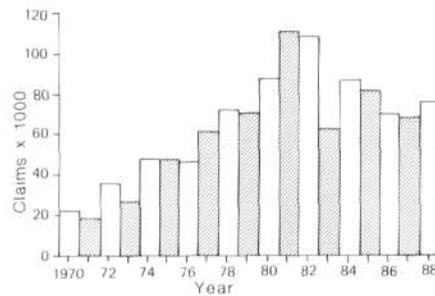


Figure 4. Claim assessment work filed in Alaska, 1970-88.



Figure 5. Regions of mineral activity in Alaska, 1988.

who were provided hand mining equipment. LITTLE SQUAW GOLD MINING COMPANY reported sampling and trenching on their claim block in the Chandalar mining district east of the Dalton Highway (loc. 3, fig. 6).

## WESTERN REGION

Alaska's western region includes the highly mineralized terranes of the Seward Peninsula (Nome, Fairhaven, Candle, Kougarok, and Council mining districts), the lower Yukon River (Ruby-Poorman and Koyukuk-Hogatza mining areas), and the upper Kuskokwim and Innoko River drainages (Nixon Fork, Innoko and Tolstoi mining districts). Reported 1988 exploration expenditures in the western region were \$3.88 million, more than triple those of 1987. Companies doing exploration in the region reported 78 persons were employed a total of 227 person-months, or the equivalent of 19 full-time jobs.

## METALS

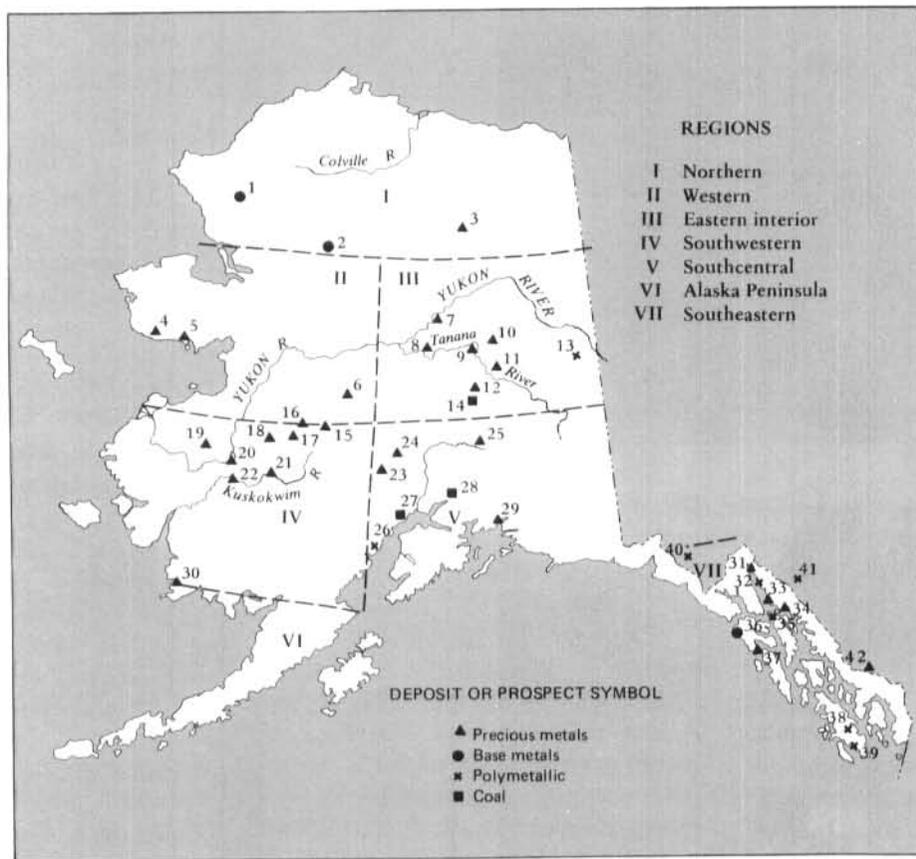
BHP UTAH INTERNATIONAL (BHP) continued exploration work for precious-metal lode deposits on land owned by the BERING STRAITS NATIVE CORPORATION (BERING STRAITS) and on lands held by NOME GOLD

JOINT VENTURE (NOME GOLD JV) (loc. 4, fig. 6). However, at the end of the field season, BHP advised NOME GOLD JV that the company was withdrawing from its exploration agreement on a 14,000-acre land parcel on the coastal plain near Nome. BHP began work on the property in May, 1988 and completed geophysical surveys and a rotary drilling program. NOME GOLD JV, held 70 percent and 30 percent by ASPEN EXPLORATION and NORTHERN GOLD, respectively, will be seeking a new partner. In addition to data collected in 1988, NOME GOLD JV holds data from some 8,000 drill holes drilled prior to 1955 on the coastal plain lands. BHP will continue its exploration program on BERING STRAITS land in 1989.

PLACER DOME U.S. INC. (PLACER DOME), also working on lands held by NOME GOLD JV, conducted a major exploration program in the Rock and Anvil Creek areas north of Nome also (loc. 4, fig. 6; fig. 7). PLACER DOME conducted a major drilling program, using both rotary and diamond drills (fig. 8). The company also carried out geochemical and geophysical surveys, and mapped and trenched a large system of en echelon gold quartz veins in metamorphic rocks. Preliminary data on the geometry, geochemistry and metallogeny of the deposit suggest that the Rock Creek prospect is a classic mesothermal, or 'metamorphic,' gold

deposit. The lands leased by the NOME GOLD JV are owned by the ALASKA GOLD COMPANY, and BERING STRAITS and SITNASUAK NATIVE CORPORATIONS.

SOLOMON GOLD CORPORATION (SOLOMON) (formerly THOR GOLD), with joint venture partners GOLDEN ZONE RESOURCES (GOLDEN ZONE) and STRATFORD AMERICAN RESOURCE CORPORATION (STRATFORD), completed a 91-hole 12,200-ft core drilling program on the Big Hurrah property 45 miles east of Nome (loc. 5, fig. 6). Under terms of the agreement by the joint venture partners, SOLOMON can earn a 70-percent interest in the property after spending US\$3.5 million over a 3-year period, after which GOLDEN ZONE and STRATFORD will hold 17.7 percent and 12.3 percent, respectively. After analysis of the summer's drill data, SOLOMON announced potential open-pit reserves of 436,000 tons grading 0.28 oz/ton gold with an 8:1 stripping ratio. The reserve estimate includes consideration of a 25-percent dilution at 0.008 oz/ton gold. The diamond-drill holes were spaced on 50-ft centers to complete definition drilling on the property. The company plans to undertake a feasibility study of the property, to be completed in early 1989. SOLOMON is listed on the Alberta Stock Exchange and is 40-percent owned by the VALHALLA



- |   |  |   |
|---|--|---|
| <p><b>NORTHERN REGION (I)</b></p> <p>1. Cominco Exploration (Noatak)<br/>NANA Corporation</p> <p>2. Cominco Exploration (Sun,<br/>Smucker)</p> <p>3. Little Squaw Gold (Little Squaw)</p> <p><b>WESTERN REGION (II)</b></p> <p>4. Placer Dome U.S. (Rock Creek)<br/>BHP Utah International<br/>Giant Bay Resources</p> <p>5. Solomon Gold (Big Hurrah)</p> <p>6. Battle Mountain Gold (Nixon Fork)</p> <p><b>EASTERN INTERIOR (III)</b></p> <p>7. Placer Dome U.S.<br/>American Copper &amp; Nickel</p> <p>8. Shoreham Resources (Tofty)</p> <p>9. Tricon Mining (Grant Mine)</p> <p>10. Fairbanks Gold (Fort Knox)<br/>BP Minerals America<br/>Yukon-Tanana Mining</p> <p>11. ASARCO</p> | <p>12. NERCO Minerals (Liberty Bell)</p> <p>13. American Copper &amp; Nickel</p> <p>14. Usibelli Coal Mine</p> <p><b>SOUTHWESTERN REGION (IV)</b></p> <p>15. American Copper &amp; Nickel</p> <p>16. Westgold</p> <p>17. Battle Mountain Gold</p> <p>18. Misco-Walsh Mining<br/>Fairbanks Gold</p> <p>19. Calista</p> <p>20. Calista</p> <p>21. Calista (Red Devil)</p> <p>22. Westgold</p> <p><b>SOUTHCENTRAL REGION (V)</b></p> <p>23. Cominco Exploration (Mt. Estelle)</p> <p>24. Golden Zone Resources (Golden Zone)</p> <p>25. Canalaska Resources</p> <p>26. Hunt, Ware &amp; Proffett (Johnson River)</p> <p>27. Placer Dome U.S.<br/>Diamond Alaska Coal</p> <p>28. Idemitsu Alaska</p> <p>29. Hayes Resources (Cliff Mine)</p> | <p><b>ALASKA PENINSULA (VI)</b></p> <p>30. Ashton Mining (Goodnews Bay)</p> <p><b>SOUTHEASTERN REGION (VII)</b></p> <p>31. Newmont Exploration</p> <p>32. Curator American</p> <p>33. Curator American (Jualin)<br/>Echo Bay - Coeur d'Alene<br/>(Kensington)</p> <p>34. Echo Bay (AJ)</p> <p>35. Greens Creek Mining</p> <p>36. Andromeda Resources</p> <p>37. Golden Sitka Resources<br/>(Chichagof)</p> <p>38. Orbex Minerals (Salt Chuck)</p> <p>39. Lac Minerals (Niblack)</p> <p><b>BRITISH COLUMBIA</b></p> <p>40. Geddes Resources (Windy Craggy)</p> <p>41. Cominco (Tulsequah Chief)<br/>Suntac Minerals (Polaris-Taku)</p> <p>42. Cominco (Snip)</p> |
|---|--|---|

Figure 6. Selected mineral exploration projects in Alaska, 1988.



Figure 7. Jim Pray, project geologist for Placer Dome U.S. Inc., stands by an outcrop hosting closely spaced gold-bearing quartz veins at Rock Creek near Nome. Photograph by C.B. Green, 1988.

GOLD GROUP CORPORATION of Vancouver, B.C.

GIANT BAY RESOURCES conducted a drilling program near Nome on acreage covered by state offshore mining leases or governed by applications for offshore prospecting permits (loc. 4, fig. 6). The company drilled 190 holes through 10 to 35 ft of ice and water and to a depth of 30 to 50 ft in the underlying sediments (fig. 9).

WINDFALL MINING CORPORATION leased ground from GLOBAL RESOURCES on Cripple River 15 miles northwest of Nome and drilled a placer gold deposit. BERGWETLESEN drilled and conducted geophysical investigations on placer ground in the Candle area. THURMAN OIL & MINING reported exploration for placer gold on several creeks in the Port Clarence and Council mining districts. KOUGAROK MINING drilled and prospected placer ground in the Kougarok mining district. KEN KRISTIANSEN conducted geologic mapping, pan sampling, and suction dredge sampling on placer claims on several creeks in the Solomon and Kateel River Quadrangles. BEEHIVE MINING sampled trenches for placer gold and platinum in the Nome mining district.

At various locations on the Seward Peninsula, ALASKA PLACER DEVELOPMENT conducted trenching and sampling of placer gravels, LOST RIVER MINING mapped and sampled several properties, and THOMAS JOHNSON tested placer ground. BATTLE MOUNTAIN EXPLORATION CO. carried out geochemical sampling, geophysics, mapping and drilling on precious-metal properties in the McGrath area and at Nixon Fork near Flat (loc. 6, fig. 6). GREEN MINING AND EXPLORATION put down 14 churn-drill holes on placer claims in the Ruby mining district. PHELPS DODGE CORPORATION conducted a property examination at an undisclosed location in the western region.

## EASTERN INTERIOR REGION

The eastern interior region, the source of much of the state's historic placer gold production, includes mineralized areas in the Alaska Range and Yukon-Tanana Upland. Reported 1988 exploration expenditures in the eastern interior region were \$6.33 million, an increase of 90 percent over 1987. Companies doing exploration in

the region reported 172 persons were employed a total of 413 person-months, or the equivalent of 34 full-time jobs.

## METALS

TRICON MINING, INC., explored for precious metals and conducted geochemical and geophysical surveying, mapping, trenching and drilling on gold-silver-antimony prospects on several claim blocks near Fairbanks (loc. 9, fig. 6).

NERCO EXPLORATION COMPANY (NERCO) carried out exploration programs for precious metals on several prospects in the region. In the Bonfield mining district, the company completed a major drilling and trenching program which outlined a significant gold-silver arsenic-enriched deposit at the Liberty Bell Mine property (loc. 12, fig. 6). In partnership with COMINCO ALASKA EXPLORATION, NERCO explored gold prospects at the Daniels/Iron Creek and Rex Creek properties. In the Fairbanks mining district, NERCO did rotary drilling, trenching, mapping and sampling at the Monzulla/Gil properties, and, in partnership with WESTERN MINING CORPORATION of Australia, did trenching, mapping, and geochemical and geophysical surveys on claims in the Fairbanks and Circle mining districts. Late in the year, NERCO announced that it was closing its exploration office in Fairbanks. NERCO will seek joint venture partners for its most promising properties.

FAIRBANKS GOLD LTD. of Vancouver, B.C., and project operator WGM INC. conducted exploration for precious-metal lode deposits at the Fort Knox property near Gilmore Dome, 15 miles northwest of Fairbanks (loc. 10, fig. 6). Based on trenching and drilling in 1988, the company has reported the potential for a 15-million-ton deposit grading about 0.06 oz/ton gold (with an 0.02 oz/ton cutoff). The Fort Knox prospect is described as a mesothermal deposit

hosted in a Cretaceous granodiorite intrusive, and, as it is reported to be Fairbanks' only known intrusive-hosted gold deposit, it may prove to be a new geologic model to explain the area's historic placer gold production of over 7 million oz.

BP MINERALS AMERICA (BP MINERALS) conducted drilling, trenching, geochemical surveying, and mapping on Cleary Summit near Fairbanks (loc. 10, fig. 6). BP MINERALS was in joint venture with a local mining company, FAIRBANKS EXPLORATION INC.; however, BP MINERALS elected to discontinue its participation in the joint venture after the 1988 season.

Roger McPherson of GRATEFUL DOG MINING reported mapping, geochemical sampling, magnetometer surveying, and auger and rotary drilling for lode deposits containing anomalous niobium, thorium and zirconium on the company's claims between O'Connor and Big Eldorado Creeks in the Fairbanks mining district. YUKON-TANANA MINING CORPORATION of Denver conducted trenching, sampling, and mapping in the Circle and Fairbanks mining districts (loc. 10, fig. 6). In the Fairbanks mining district, THURMAN OIL & MINING reported exploration for placer gold on several creeks; COOK'S MINING drilled for placer gold near the mouth of Fairbanks Creek; and M. DENNIS SHEPARD and partners conducted geophysical surveys and dug test pits exploring for precious-metal lode deposits on the Murray-Merlyn property.

PLACER DOME conducted mapping and geochemistry on DOYON, LIMITED (DOYON) lands near the village of Rampart in the Rampart mining district (loc. 7, fig. 6). AMERICAN COPPER & NICKEL COMPANY, INC., explored for precious-metal lode deposits on state claims and on lands owned by DOYON in the region. In the Rampart mining district, the company did mapping, geochemical surveys, and airborne electromagnetic and mag-



*Figure 8. A drill rig samples the Rock Creek prospect of Placer Dome U.S. Inc. Photograph by C.B. Green, 1988.*

netic surveys on state claims and DOYON lands southeast of the village of Rampart (loc. 7, fig. 6). In the Eagle area, the company did geochemical and geophysical surveys and conducted a core drilling program on DOYON lands and state claims northwest of the village of Eagle (loc. 13, fig. 6). WILLFORD MINING conducted mapping and geochemical sampling, and dug test holes with a tractor and backhoe to evaluate placer gold claims

on Hoosier Creek in the Rampart mining district.

SALTER & ASSOCIATES, INC., conducted geophysical surveys, did field mapping and sampled test holes on the company's placer claims in the Eureka mining district. SHOREHAM RESOURCES drilled a gold, silver, and tin placer property at Tofty Mountain in the Hot Springs mining district (loc. 8, fig. 6).

In the Circle mining district,



Figure 9. A drill line is cleared on Norton Sound ice for the exploration of state offshore mining leases near Nome by Giant Bay Resources. Photograph by T.K. Bundtzen, 1988.

RAY WOLF spent 21 days mapping, sampling, stripping and staking gold placer claims on Harrison Creek; RON WREDE did assessment work and staked new placer claims on Deadwood Creek; LYLE COLLEDGE spent 3 weeks churn-drilling placer claims on Bottom Dollar Creek; HELEN WARNER MINING mapped the Horn and Antler claim groups; POINTS NORTH conducted lode and placer exploration on claims in the Portage Creek area; and DISCOVERY MINING prospected placer ground.

ASARCO INCORPORATED (ASARCO) carried out geologic mapping and diamond drilling for precious-metal lode deposits in the Richardson mining district (loc. 11, fig. 6), but reported that the company

has terminated its option with TRI-VALLEY MINING (TRI-VALLEY), the property holder. In late 1988, TRI-VALLEY processed a 73-ton bulk sample at the Grant mill in Fairbanks and plans to carry out additional bulk sampling, surface trenching, and drilling in 1989. ASARCO estimates that the Democrat lode deposit contains one million tons of ore grading 0.04 oz/ton gold. In the region, FAIRBANKS EXPLORATION INC. did geologic mapping, alteration mapping, and rock sampling for precious and base metals. The company also participated in a joint venture with BP MINERALS at Cleary Summit near Fairbanks. Also in the region, MT. SI, INC. conducted mapping and sampling on the corporation's placer claims in the Miller Mountain-Amy Creek

drainage near Isabel Pass in the Alaska Range; JENSEN MINING & CONSTRUCTION prospected for precious-metal placer deposits in the eastern Alaska range; P&S MINING prospected for precious-metal placer and lode deposits by geochemical and geophysical surveying, and trenching; RECOVERY SYSTEMS prospected for gold placers in the Wood Creek area; and MOHAWK OIL & GAS completed assessment work on company claims.

## COAL

USIBELLI COAL MINE, INC., (UCM) continued exploration drilling on the company's state coal leases near Healy. Usibelli is exploring new areas to develop in anticipation of the exhaustion of subbituminous coal reserves at the Poker Flats production pit in 9 to 10 years (loc. 14, fig. 6).

FAIRBANKS EXPLORATION INC. reported exploration activities for coal in the Jarvis Creek coalfield near Delta Junction.

## INDUSTRIAL MINERALS

ALASKA LIMESTONE COMPANY sampled and excavated bulk samples of limestone at their project site near Cantwell. FAIRBANKS EXPLORATION INC. reported exploration activities for industrial minerals during the 1988 season.

## SOUTHWESTERN REGION

The Late Cretaceous-early Tertiary volcanic and plutonic rocks of the southwestern region are the source of over 2.4 million oz of past gold production and the focus of several current precious metal exploration programs. Reported 1988 exploration expenditures in the southwestern region were \$2.63 million, a fourfold increase from 1987. Companies doing exploration in the region reported 70 persons were employed a total of 125 person-months, or the equivalent of 10 full-time jobs.

## METALS

The CALISTA CORPORATION (CALISTA), a regional native corporation with a land entitlement of nearly 7 million acres in the southwestern region, conducted four reconnaissance exploration programs on corporation lands. CALISTA reports that this was the first year significant local employment and economic benefits were realized from efforts to explore and eventually develop mineral resources on corporation land. CALISTA crews of one to three persons conducted mapping and sampling for precious metals in the Russian and Horn Mountains, in the Nyac area (loc. 20, fig. 6), and in the Red Devil mining district (loc. 21, fig. 6). In the Marshall Hills north of Russian Mission and east of Holy Cross, CALISTA conducted mapping and sampling for precious and base metals on Kako and Stuyahok Creeks (loc. 19, fig. 6). The corporation reports that it is actively looking for partners on these properties. WESTGOLD explored for gold on lands leased from CALISTA near Donlin Creek and conducted mapping, trenching, soil and rock sampling, and core and auger drilling (loc. 22, fig. 6).

MISCO-WALSH MINING CO. exposed the gold-silver-tungsten vein system of the Golden Horn Mine by hydraulically stripping a covering layer of weathered monzonite (loc. 18, fig. 6). An area 500 ft by 250 ft was exposed, and trenches were excavated across the strike of the vein system and at the sides of the stripped area. The exposed bedrock area includes the site of the 1922 discovery shaft and headframe. The company will continue its surface work in 1989. The hydraulically excavated material was essentially a residual placer, and the company sluiced and processed this material. (See Production section.)

FAIRBANKS GOLD LTD., headquartered in Vancouver B.C., explored for precious-metal lode deposits on lands owned by DOYON near Flat, Alaska (loc. 18, fig. 6).

AMERICAN COPPER & NICKEL explored for precious-metal lode deposits on state claims and on lands owned by DOYON in the region. The company conducted mapping, geochemical surveys, and airborne electromagnetic and magnetic surveys on DOYON lands in the Stone Mountain area northeast of McGrath, and on DOYON lands and state claims in the Candle Hills area south of McGrath (loc. 15, fig. 6).

COMINCO ALASKA EXPLORATION, in partnership with AMERICAN ULTRAMAR LTD., did diamond drilling on a tin and precious-metal prospect in the Taylor Mountain Quadrangle. WESTGOLD staked a claim block on a gold-silver-bearing dike swarm in the Ganes-Yankee Creek area west-southwest of McGrath (loc. 16, fig. 6). BATTLE MOUNTAIN EXPLORATION COMPANY conducted reconnaissance exploration regionwide and examined gold prospects at Granite Creek near the headwaters of the George River (loc. 17, fig. 6). In the Iditarod mining district, LYMAN RESOURCES tested placer ground leased from CALISTA, and JULIAN CREEK MINING conducted placer and lode gold exploration on claims in the George River drainage. DONALD HARRIS conducted geophysics and trenching activities on placer ground in the Moore Creek area northeast of Flat, and JOHN D. MURPHY and JAMIN KLOPPMAN prospected for precious-metal lode deposits in the Upper Titnuk River. CINNABAR CREEK ALASKA conducted geochemical sampling, panning and chip sampling, and trenching at their Cinnabar Creek lode and placer property in the Kuskokwim Mountains.

## SOUTHCENTRAL REGION

The southcentral region encompasses mineralized terranes on the southern flank of the Alaska Range, the Chugach and Wrangell Mountains, and the Kenai Peninsula. Reported

1988 exploration expenditures in the southcentral region were \$9.19 million, more than doubling 1987 expenditures. Companies doing exploration in the region reported 191 persons were employed a total of 678 person-months, or the equivalent of 56 full-time jobs.

## METALS

COMINCO ALASKA EXPLORATION (COMINCO) continued work on the company's Mt. Estelle gold prospect near the Rainy Pass area 150 miles northwest of Anchorage (loc. 23, fig. 6). The company conducted geologic mapping and geophysical investigations and carried out a diamond drilling program (fig. 10). COMINCO operates the project in which PLATINOVA RESOURCES of Toronto holds a minority interest. CANALASKA RESOURCES of Vancouver, B.C., completed a field program on the company's Rainbow Hill lode gold prospect 90 miles east of Cantwell in the Valdez Creek mining district (loc. 25, fig. 6). Two mineralized zones, the Lucky Hill and Black Creek, were identified as drill targets for next season's program. The company is exploring for bulk-tonnage mineralization in calcareous, carbonaceous metasedimentary rocks.

GOLDEN ZONE RESOURCES, with joint venture partner UNITED PACIFIC GOLD LTD. (UNITED PACIFIC) completed a two-stage exploration program on the Golden Zone property in southcentral Alaska, 135 miles north of Anchorage (loc. 24, fig. 6). A diamond drilling program was completed in August that tested the deposit's surface-exposed breccia pipe and adjacent wall rocks. The second stage of the exploration program, completed in November, consisted of reverse circulation drilling done on a 50-ft by 50-ft grid to confirm the continuity of mineralization defined by earlier core drilling and other data. Additionally, a 1,600-ft underground crosscut was driven by contractor ALASKA HARD ROCK MINING COMPANY. The proven



Figure 10. A drill rig is silhouetted at the Cominco Alaska Exploration's Mt. Estelle project in the southern Alaska Range. Photograph by Madelyn Millholland, courtesy of Cominco Alaska Exploration, Inc., 1988.

and probable geologic reserves at the Golden Zone property as announced in February 1988 are 1.16 million tons grading 0.179 oz/ton gold, 0.675 oz/ton silver, and 0.207 percent copper. The company expects to undertake a feasibility study for the Golden Zone property in 1989. The corporate structure of the Golden Zone project underwent several changes in 1988. GOLDEN ZONE DEVELOPMENT LTD., headquartered in Anchorage, who financed the earlier exploration on the Golden Zone property, was reorganized as GOLDEN ZONE RESOURCES INC., with headquarters in Campbell, California. Additionally, UNITED PACIFIC

became a joint venture partner in the project by committing to spend \$2.5 million to bring the property through the feasibility stage and an additional \$3.5 million to earn a 50-percent interest in the venture. However, failure by UNITED PACIFIC to meet its payment schedule in late 1988 resulted in reversion of full ownership to GOLDEN ZONE RESOURCES.

AMAX EXPLORATION INC. carried out reconnaissance rock sampling, soil sampling, and drilling on several state and federal claim blocks in the southcentral region. SUNSHINE MINING CO. used a 3-inch auger drill to sample for gold, tungsten, and platinum in placer bench de-

posits in the Knik River area. HUNT WARE & PROFFETT managed a diamond drilling program for a client leasing the Johnson River property (loc. 26, fig. 6) on the Alaska Peninsula from landowner COOK INLET REGION, INC. The Johnson River gold-zinc-copper-lead-silver deposit is a steeply dipping stockwork of quartz-sulfide veinlets within a silicified zone surrounded by anhydrite alteration. The deposit is in Lower Jurassic tuffs and tuffaceous sedimentary rocks of the Talkeetna Formation, east of the Bruin Bay fault.

GOLD CORD MINING COMPANY in the Willow Creek mining district reported drilling, adit rehabilitation, and access road construction at the company's lode-gold property on Fishhook Creek. BLACK SANDS MINING CO. conducted surface and underground work on their Arch precious-metal lode property in the Willow Creek mining district. The company stripped the lode vein and took surface samples, mucked out and retimbered cave-ins, drove 20-ft and 30-ft crosscuts on the 100 and 200 levels, respectively, and made improvements to the property's access road. FREDERICK HAAS used a suction dredge to sample placer claims on the Kenai Peninsula.

In the Seward mining district, GOODROCK PLACER ASSOCIATION used a suction dredge to sample bedrock on their placer claim and KURT BITTLINGMAEIR pansampled placer claims on Ingram Creek. Gene Granatt of I.I.S. MACHINE INC. reported digging prospect holes, suction-dredge sampling, and milling small samples from placer gold claims in the Seward mining district.

GOLD DUST MINES, INC., did geophysics, mapping, and trenching in the Chistochina mining district.

BUSCH CREEK MINING dug test holes with a backhoe and sampled placer gravels with a small sluice box on the company's claims in the Talkeetna area. FINNBEAR MINING

& EXPLORATION COMPANY INC. blasted a test pit, took a 50-lb sample to be analyzed for gold and platinum, and sank and cribbed a short shaft on high-grade gold-bearing vein material on the company's claims in the Kahiltna River drainage. H & H EXPLORATION AND MINING used a backhoe to dig test holes on placer gold claims in the Fairview Mountains. MURRAY L. JONES sampled for precious metals on placer claims in the Talkeetna mining district.

CHUGACH ALASKA INC. conducted sampling and geochemistry on corporation lands in the Copper River Valley.

HAYES RESOURCES-DASHER RESOURCES JOINT VENTURE, using WGM INC. as operator, continued underground rehabilitation, mapping, channel sampling, and dewatering of below-sea-level workings at the Cliff mine property on Valdez Arm near the Port of Valdez (loc. 29, fig. 6). PHELPS DODGE CORPORATION conducted property examinations at undisclosed locations in the region.

## COAL

In the Matanuska coalfield (loc. 28, fig. 6), IDEMITSU ALASKA INCORPORATED (IDEMITSU) carried out a major drilling program, did geophysical logging, conducted shallow high-resolution seismic surveys, took a 13-ton bulk sample, began permitting and environmental baseline studies (fig. 11) on the company's eight state coal leases, and completed a mine feasibility study. The study indicated that production from the coal leases has the potential to compete internationally on cost and quality bases. IDEMITSU announced in June 1988 that UNION PACIFIC RESOURCES, its partner in the Wishbone Hill Coal Project, had withdrawn from the project. IDEMITSU acquired UNION PACIFIC's interest and continued exploration activities, using MCKINLEY MINING CON-



Figure 11. Consultants conduct baseline environmental studies on Idemitsu coal leases. Photograph by David Germer, courtesy of McKinley Mining Consultants, 1988.

SULTANTS of Palmer for project management. IDEMITSU is a subsidiary of IDEMITSU KOSAN of Tokyo, Japan's largest independent petroleum company. IDEMITSU KOSAN operates a coal import terminal in Tokyo Bay, uses coal in its oil refineries, and supplies coal, oil, and gas to many Japanese power utilities. IDEMITSU KOSAN is currently finalizing arrangements with Japanese power utilities who are scheduled to bring new generating units online in 1990 and 1991. Under a preliminary project schedule, IDEMITSU would obtain necessary permits in 1990 and complete mine construction and start production by 1991, to accommodate the market opportunity. Project plans call for mining up to 1.1 million short tons/year and exporting the bituminous coal through SUN EEL ALASKA'S coal loading terminal in Seward.

PLACER DOME U.S. INC. took a bulk sample and conducted 250 ft of rotary drilling in the Center Ridge area of its coal leases in the Beluga

coalfield near Cook Inlet (loc. 27, fig. 6). The lease area, which is owned by COOK INLET REGION, INC., has announced reserves of 500 million tons of subbituminous coal.

DIAMOND ALASKA COAL COMPANY continued environmental monitoring, secured mine permits, participated in administrative hearings (completed in June 1988) on the issuance of the company's state mining permit, and continued marketing efforts towards the development of the company's state coal leases in the Beluga coalfield on the west side of Cook Inlet (loc. 27, fig. 6).

During 1988, CHUGACH ALASKA CORPORATION worked on plans for access and surface mapping for future development of the corporation's Bering River coal deposits.

## INDUSTRIAL MINERALS

SAFAR CONSTRUCTION CO. explored for gravel deposits in the Girdwood-Portage area.

## ALASKA PENINSULA

The Alaska Peninsula region contains nearly 50 active volcanoes of the Alaska-Aleutian Island arc. Mineral exploration in the area has focused on precious-metal-enriched calderas, fault zones and porphyry copper-molybdenum deposits. Reported 1988 exploration expenditures in the Alaska Peninsula region were \$1.80 million, more than doubling 1987 expenditures. Companies doing exploration in the region reported 18 persons were employed a total of 74 person-months, the equivalent of 6 full-time jobs.

### **METALS**

BATTLE MOUNTAIN EXPLORATION CO., under exploration agreements with the ALEUT NATIVE CORPORATION, conducted a major exploration program for precious metals in the Port Moller, Cold Bay, False Pass, and Stepovak Bay Quadrangles. ALASKA APOLLO GOLD MINES LTD. (ALASKA APOLLO) constructed a new camp and improved the project road at its Apollo, Sitka, and Shumagin properties on Unga Island. In January 1988, ALASKA APOLLO announced that NEVADA GOLDFIELDS CORPORATION had signed a 90-day letter of intent giving that company the option to earn a 51-percent interest in ALASKA APOLLO'S Unga Island assets by investing approximately \$10 million in the development of the Shumagin property. However, it was announced in late March 1988 that NEVADA GOLDFIELDS would not exercise the option. On the basis of exploration work done between 1983 and 1987, ALASKA APOLLO reports reserves of 278,201 tons that grade 0.524 oz/ton gold and 2.47 oz/ton silver at its Shumagin property. ASHTON MINING explored for platinum on mining claims and on land leased from the CALISTA CORPORATION in the Goodnews Bay area (loc. 30, fig. 6). The company conducted

geochemical and geophysical surveys, and did geologic mapping and core drilling. BRISTOL BAY NATIVE CORPORATION took geochemical samples and made site investigations for precious metals on corporation lands in the region. The corporation is interested in seeking agreements with mining companies to explore various mineral deposits. HOWARD BOWMAN conducted magnetometer surveys and sampled test pits on gold placer claims on Portage Creek near the north shore of Lake Clark. PHELPS DODGE CORPORATION conducted a property examination in the region.

### **INDUSTRIAL MINERALS**

BRISTOL BAY NATIVE CORPORATION made site investigations for gravel sources on corporation lands. The corporation sells gravel for regional construction projects.

## SOUTHEASTERN REGION

The southeastern region includes a rugged ice-capped mainland and over 1,000 islands of the Alexander Archipelago. Much of the region lies within the Tongass National Forest, which is principally managed for the multiple use of its lands; about 65 percent of the forest is presently open for mineral entry. Alaska's largest historic lode gold producing mines were located in the Juneau Gold Belt, and several major precious-metal exploration programs are underway in that area. The region also hosted many small precious- and base-metal mines which operated intermittently during the first half of the century, and many of these are now being reevaluated. Reported 1988 exploration expenditures in the southeastern region were \$20.6 million, more than tripling 1987 expenditures. Companies doing exploration in the region reported 188 persons were employed a total of 1,200 person-months, an equivalent of 100 full-time jobs.

### **METALS**

ECHO BAY EXPLORATION (ECHO BAY) continued aggressive exploration of the historic AJ and Perserverance mines in Juneau, working for 365 days in 1988 (loc. 34, fig. 6). ECHO BAY MINES holds an 85-percent interest in the project with WATTS, GRIFFIS AND MCQUAT LTD. (WGM) holding a 15-percent carried interest. In addition to a 50,000-ft diamond-drilling program, ECHO BAY drove 2,700 ft of underground decline and crosscuts (fig. 12), rehabilitated 18,000 ft of existing underground workings, took 9,900 ft of channel samples, mined 500 tons of ore for metallurgical testing (fig. 13), did geotechnical and mine openings design work, and tested blasting and cratering techniques. The results of the 1988 work program are expected to provide sufficient information to allow the company to proceed with a final feasibility study in the first half of 1989.

In February 1989, ECHO BAY intends to begin seeking regulatory authorization for the construction of the AJ mining project. Preliminary development plans envisage a 20,000 ton/day underground mining operation producing 250,000 oz of gold per year. The mine is expected to have a capital cost of \$160 million and would employ a workforce of 450 to exploit the low-grade (0.047 oz/ton) vein deposit during an estimated operating life of 15 years. The mining method would be long-hole, open-stopping. All crushing, grinding, and concentrating facilities, with the exception of final end-product processing, would be constructed underground. Access to the mine would be through an 11,000-ft long adit with 20-ft by 20-ft cross sectional dimensions. The adit portal would be located at tidewater, approximately 2.5 miles south of Juneau. Additional support facilities would be located adjacent to the portal. Tailings would be impounded behind a dam located in the Sheep Creek valley and a 4.5-

megawatt hydroelectric plant would be constructed at the tailings dam.

ECHO BAY, with joint venture partner COEUR ALASKA INC. (a subsidiary of COEUR D'ALENE MINES), constructed a camp at the Kensington gold property near Berners Bay, 40 miles north of Juneau (loc. 33, fig. 6). During the peak field season, the camp housed 52 workers, and about 30 workers remained by year's end. A 2-1/2-mile road was built by SOUTHCOAST CONSTRUCTORS (SOUTHCOAST) from the beach at the site of the old Comet Mine property on Lynn Canal, midway between Haines and Juneau, to the new Kensington portal site at the 800-ft level (fig. 14). SOUTHCOAST also received the contract to drive a 15-ft by 20-ft exploration adit. By year's end, the adit was driven 5,400 ft and had intersected the main Kensington vein; although assays had not yet been returned, company geologists estimated that the vein system contains 70 ft of mineable ore with about 20 ft of marginal ore on either side. The exploration adit confirmed the continuation of the ore zone, which was intercepted at the 1,900-ft level in a drilling program conducted by the previous owner, PLACID OIL. The Kensington ore zone remains open along strike and depth. ECHO BAY will continue drilling in 1989 to delineate the vein system and will prepare a bulk sample for shipment to the Lakefield Laboratory in Toronto for metallurgical testing. The Kensington ore is unique among Juneau Gold Belt deposits as it contains telluride minerals which require more complex recovery methods. At the end of 1988, announced reserves were 7.4 million tons, grading 0.14 oz/ton gold. Exploration work at the property in 1989 will include driving a raise and decline to connect the two mine levels. The company will complete feasibility studies and determine key development alternatives. ECHO BAY is conducting baseline environmental studies for the potential marine disposal of mine tailings, and will carry out technical



Figure 12. Two miners drill blastholes at the face of an exploration crosscut at the AJ mine in Juneau. Photograph by Rick Fredricksen, courtesy of Echo Bay Mines, 1988.



Figure 13. Bags containing bulk ore samples from the AJ mine in Juneau await barge shipment for metallurgical testing. Photograph by Rick Fredricksen, courtesy of Echo Bay Mines, 1988.



Figure 14. An underground loader enters the 800 level exploration adit at the Kensington mine project near Berners Bay in southeast Alaska. Photograph by Al Clough, 1988.

studies to support an intermediate level feasibility study scheduled to be completed by the end of 1989. If the results of the feasibility study are positive, ECHO BAY anticipates development of a 6,000 ton/day underground mine with startup scheduled for 1992. Although ECHO BAY also manages the AJ mine project, the two programs are managed from separate offices. During 1988, the company joined with the GREENS CREEK MINING COMPANY and the University of Alaska in sponsoring mine safety training programs to qualify area residents for the growing number of underground mining jobs in the Juneau area.

CURATOR AMERICAN (CURATOR) constructed a 5-mile road from Berners Bay to the site of the Jualin Mine property also (loc. 33, fig. 6; fig. 15). The design, final permitting, and construction of the road was completed in a single season and was accomplished with the cooperation of the Southeast Alaska Conservation Council (SEACC).

SEACC participated in designing the road route, in setting construction standards and aircraft schedules, and in monitoring construction. The company also conducted a 12,500-ft drilling program, bringing total diamond-core drilling on the property to over 30,000 ft. CURATOR announced that the property contains proven reserves of 238,000 tons grading 0.309 oz/ton gold and probable and possible reserves of 1.04 million tons that grade 0.30 oz/ton gold.

The Jualin Mine property is owned by HYAK MINING COMPANY of Juneau and operated by CURATOR under a lease to explore and develop the deposit. The property historically produced 70,000 tons of ore with an average grade of 0.56 oz/ton gold. Located in the Juneau Gold Belt adjacent to the Kensington Mine property held by ECHO BAY, the Jualin Mine is a diorite-hosted quartz-vein shear zone system comprising five parallel fissure veins. The shear zone system is open at depth and along strike.

In 1988, surface work indicated the existence of numerous other exploration targets on the property, including the newly discovered Big Lake vein, which provided chip samples averaging 0.445 oz/ton gold from the 1,200-ft strike length sampled in 1988.

In 1989, CURATOR will continue surface drilling and exploration of the Jualin shear zone and the Big Lake vein, as well as driving an 800-ft decline on the shear zone to facilitate bulk sampling and underground drilling. The company will also expand barge and float plane facilities at the Berners Bay road terminus.

CURATOR carried out a helicopter-supported mapping and rock, soil and sediment sampling program on the 'Dream' massive sulfide prospect 58 miles north-northwest of Juneau and 15 miles south of Haines (loc. 32, fig. 6). The Dream prospect was discovered in 1987 by Al Clough of the Juneau Office of the U.S. Bureau of Mines, and the claims are held by Juneau prospectors Roger Eichman, Dale Henkins, and Floyd Branson. The prospect contains stratabound/stratiform mineralization enriched in gold, silver, cobalt, copper, lead, and zinc, and is hosted in the Alexander Terrane, which also hosts the Greens Creek and Windy Craggy deposits.

The 1988 work identified three distinct zones of mineralization, including a gold- and cobalt-rich zone, a copper-rich zone, and a zinc-lead-enriched zone. Abundant quartz veins and locally mineralized breccia zones have also been identified.

CURATOR staked an additional claim block of over 10,000 acres, known as the 'Opus,' which surrounds the Dream claim group and extends to tidewater on Lynn Canal.

CURATOR completed a geologic mapping and rock, soil, and sediment sampling program on the Gold Fork prospect 7 miles east of Juneau. Located within the Juneau Gold Belt, the property encompasses 1,100 acres near the eastern boundary

of ECHO BAY's AJ mine project. CURATOR acquired the Gold Fork property, formerly known as the Pioneer and Clark claim groups, under a lease agreement from local prospectors. The company is planning a 5,000-ft diamond drilling program in 1989 to test four gold-bearing quartz-vein structures on the property.

The GREENS CREEK MINING COMPANY (GREENS CREEK) conducted drilling and trenching on claim groups northwest of the Greens Creek mine site (loc. 35, fig. 6), including the Hi East, Hi West, and Mammoth groups, which are optioned from other companies, and the Li'l Sore, Fowler, and Mariposte claim groups held by GREENS CREEK.

FMC GOLD conducted geochemical and geophysical surveying, mapping, and drilling at Treasure Hill in the Auke Bay area. MONUMENT carried out a drilling program on the Bessie property near Eagle River in the Juneau Gold Belt. ECHO BAY carried out work on a small vein system near the mouth of Herbert Glacier. WHELAN EXPLORATION also worked in the same area. REGENT ALASKA did mill and metallurgical tests on samples taken from the Grizzly Bar-Oozy Flats area at Sunny Cove near the Taku Glacier. HAZELTON, an Australian-based company, did metallurgical testing on samples taken from the tailings dump at the AJ mine, adjacent to ECHO BAY's proposed AJ mine portal site.

NEWMONT EXPLORATION LTD., a subsidiary of NEWMONT MINING, carried out a drilling program for precious-metal lode deposits near Haines, Alaska (loc. 31, fig. 6). SALISBURY-DIETZ carried out a helicopter-supported drill program on claims located on the Chilkat Peninsula.

ANTILLES RESOURCES LTD. conducted geochemical sampling, mapping, and trenching at Smugglers Cove on Helm Bay in the Ketchikan Recording District. The company is evaluating the precious metal potential of 60 lode claims. The HARLOW

CORPORATION churn-drilled and sampled placer claims in the Ketchikan mining district and had work done on developing a process for recovering precious and other metals from the deposit.

GOLDEN SITKA RESOURCES INC. (GOLDEN SITKA) rehabilitated underground workings and did 3,000 ft of core drilling at the Hirst-Chichagof mine property 50 miles northwest of Sitka (loc. 37, fig. 6). The object of the drilling program was to assess the inferred extension of the 'Kay' ore shoot below previously developed mine levels. However, four of the six diamond drill holes intercepted a barren aplite dike with only minor quartz veining at the expected ore zone. The company announced in late 1988 that it had

relinquished its option on the Hirst-Chichagof property. Planned work by GOLDEN SITKA at the neighboring Chichagof property, including a 5,000-ft drilling program, was also halted late in the year after a fire destroyed the project's camp. The company had driven a bypass around an old production stope in the Chichagof Mine to access the face of the Golden Gate adit and planned to explore extensions of vein systems by extending the adit and driving crosscuts. However, in view of the high cost of winter operation, pending a complete review of the project, GOLDEN SITKA announced that operations at the project would be temporarily suspended. Previously announced reserves at the Chichagof mine were 60,000 tons, grading 0.6 oz/ton gold.



Figure 15. Construction proceeds on a road linking the Jualin mine site to tidewater at Berners Bay. Photograph by John Barnett, courtesy of Curator American, Inc., 1988.

Several local Juneau companies and prospectors were active during the year. HYAK MINING conducted exploration for precious metals in the Juneau Gold Belt. The EICHMAN brothers worked on the Lady Luck I and II and E. Pluribus Unum claims. HOWARD HAYES worked on the Endicott River claim group, and DALE HENKINS worked on the Crystal claims.

ANDROMEDA RESOURCES INC., a wholly-owned subsidiary of GALACTIC RESOURCES LTD., conducted diamond drilling and made improvements on their nickel-copper-cobalt claims at Mirror Harbor and Yakobi Island (loc. 36, fig. 6). The company, along with joint venture partner TOUCHSTONE RESOURCES, holds lode claims in the Bohemia Basin on Yakobi Island that contain announced reserves of 16.2 million tons that grade 0.31 percent nickel, 0.18 percent copper, and 0.02 percent cobalt.

WGM INC. did channel sampling and mapping on the LCM property near Sitka and on the Apex-El Nido property on Chichagof Island. SEALASKA CORPORATION did geologic mapping and rock and stream sediment geochemistry on corporation lands in the region, exploring for base and precious metals and industrial minerals.

Operator LAC MINERALS (USA) INC., in partnership with NORANDA EXPLORATION INC., conducted drilling, mapping, and geochemistry on the Niblack and Ruby Tuesday precious-metal-enriched massive sulfide properties on Prince of Wales Island (loc. 39, fig. 6), and conducted trenching, mapping, sampling, and drill site preparation on the Kaigani polymetallic property on Dall Island. Through the end of 1988, the company had completed 24,000 ft of drilling at the Niblack deposit, which contained grades of up to 4.9 percent copper, 8 percent zinc, and 0.27 oz/ton gold.

COMINCO ALASKA EXPLORATION, in partnership with BP

MINERALS, did geochemistry, geology, and diamond drilling on claims on Woewodski and Zarembo Islands. The company also did mapping and sampling in the Petersburg Quadrangle.

ORBEX METALS LTD., in joint venture with AMERICAN PLATINUM INC., both of Vancouver, B.C., continued geochemical surveying and mapping on the Salt Chuck, Rush, and Brown mine properties on Prince of Wales Island (loc. 38, fig. 6). The company is evaluating the properties for gold, platinum-group metals, and copper. Selected samples from the Salt Chuck property have assayed up to 7.8 percent copper, 0.25 oz/ton palladium, and 0.07 oz/ton platinum. The deposit is hosted in an 'Alaska-type' zoned ultramafic complex.

NERCO EXPLORATION COMPANY conducted geologic mapping, sampling, and geochemical surveying on several claim blocks in the Ketchikan and Petersburg mining districts.

There were no field activities other than road and camp maintenance at U.S. BORAX AND CHEMICAL CORPORATION's (U.S. BORAX) Quartz Hill molybdenum project near Ketchikan. However, the project's Final Environmental Impact Statement and accompanying Record of Decision were issued by the US Forest Service on October 24, 1988. Of primary importance, both the Forest Service and EPA concurred with the company's preferred marine tailings disposal site in Wilson Arm/Smeaton Bay. EPA is expected to issue an NPDES permit for the tailings discharge in 1989.

The issuance of the Final EIS and Record of Decision marks the fourteenth year of effort by the company to explore and sample the huge molybdenum deposit, to carry out baseline environmental studies, and to obtain necessary environmental permits and determinations prior to beginning full-scale mine development. U.S. BORAX has announced the company will await favorable market

conditions before proceeding with mine development and construction. With announced reserves of about 1.5 billion tons of ore that grade 0.14 percent molybdenum disulfide, the deposit could produce about 2.1 million tons of molybdenum over an estimated 55-year mine life. Between the time of the discovery of Quartz Hill in the 1970s and the present, the land surrounding the project's federal mining claims was changed from multiple-use forest land to a National Monument while the market demand and price of molybdenum, a steel alloy, dropped dramatically. Though the discovery and initial work on the Quartz Hill mining claims predated by many years the reclassification of the surrounding land to wilderness status, the project received national attention in the debate over resource development on federal lands in Alaska.

## NORTHWESTERN CANADA

### BRITISH COLUMBIA

Exploration expenditures in British Columbia in 1988 are estimated to be Can\$150 million (US\$128 million), down from record high expenditures of Can\$192 million (US\$163 million) in 1987 (Preto, 1989). As in Alaska, the main focus of exploration was for precious metals.

The British Columbia Ministry of Energy, Mines and Petroleum Resources reported several programs, legislative changes, and incentives that have been supportive of mineral exploration in the Province. A record number of field programs by the provincial geological survey were undertaken, including 10 regional mapping projects in poorly-explored areas, expanded mineral deposit mapping, regional geochemical surveys, and industrial minerals and land-use studies. Also, a Prospectors Assistance and Training program was established and a new Mineral Tenure Act was introduced which replaces and streamlines its predecessor. Finally, the Province's

computerized minerals deposit database, MINFILE, was adapted for use by micro-computers. Data files with corresponding mineral occurrence maps were made available in hard copy or on floppy diskette for nominal fees. Also, a simple search program was made available to allow users to query the database. Funding for the implementation of the programs has resulted from a significantly expanded operational budget and from a 5-year Canada/British Columbia Mineral Development Agreement in which federal support to the provinces is provided to encourage mineral development.

The Stewart-Iskut River gold belt, adjacent to Alaska, was the busiest exploration area in northwestern British Columbia, with Can\$43 million (US\$37 million) expended on 55 properties in 1988. A regional geochemical survey of stream sediment samples by the British Columbia Geological Survey for the Iskut River, Telegraph Creek, Sumdum, and Tulsequah Chief map quadrangles was released in July 1988 and resulted in a significant increase of mining exploration in the area.

COMINCO LTD. and partner DELAWARE RESOURCES continued advanced exploration work on the Snip property in the Iskut River area of British Columbia near Wrangell, Alaska (loc. 42, fig. 6). During the 1986-87 programs, 50,000 ft of drilling delineated several steeply dipping, high-grade gold-bearing vein structures. During 1988, the companies carried out underground drifting that revealed two distinct ore types. Indicated and inferred ore reserves are estimated at 1.57 million tons that grade 0.64 oz/ton gold. This estimate assumes a 25-percent mining dilution and minimum 6-ft mining width. The deposit may be hosted in Jurassic turbidite sediments geologically similar to those in the Chichagof mining district north of Sitka and other 'mesothermal' gold systems in southeastern Alaska. Metallurgical tests on underground bulk samples and drill core composites

indicated combined gravity and cyanidation recoveries of 91 to 98 percent gold. Underground exploration of the Snip deposit is continuing, and preliminary engineering is underway for the construction of mill, tailings disposal, and surface facilities. Startup is anticipated in late 1989 for a 330 ton/day operation. Logistical support for the Snip project, for the Johnny Mountain Mine, and for other mining projects in the Iskut River area of British Columbia is maintained by air through Wrangell. (See Development section for further discussion.)

COMINCO LTD. (60 percent) and partner REDFERN RESOURCES LTD. (40 percent) continued exploration of the Tulsequah Chief property located 40 miles east of Juneau, Alaska, just inside the Canadian border (loc. 41, fig. 6). The property is located on the Tulsequah River, a tributary of the Taku River, and is accessed by air from Juneau or from Atlin, B.C., via Whitehorse. The Tulsequah Chief claims were originally developed in 1951 by COMINCO and produced 625,781 tons of copper, lead, zinc, gold, silver ore at a rate of 530 ton/day, until low metal prices forced mine closure in 1957. Ore concentrates were shipped down the Taku River for shipment to smelters. Surface drilling, mapping, and sampling were conducted in 1987, and, in 1988, 2,500 ft of underground workings were rehabilitated, and an underground drilling program was carried out. As a result of the recent exploration, ore reserve estimates have increased from 780,000 tons at the time of mine closure in 1957 to 2.38 million tons in 1988, at grades of approximately 1.3 percent copper, 1.6 percent lead, 8.0 percent zinc, 0.07 oz/ton gold, and 2.9 oz/ton silver. In 1989, underground workings will be extended to allow deeper underground drilling to further expand reserves. Project operators would prefer to use Juneau as a transportation, service, and supply center, but delays in gaining necessary approvals from U.S. Customs forced the project in 1988 to

route support through Atlin, B.C., via Whitehorse.

SUNTAC MINERALS of Vancouver, B.C., began exploration of the Polaris-Taku mine 40 miles east of Juneau (loc. 41, fig. 6). The Polaris-Taku operated from 1938 to 1951 and produced 230,000 oz of gold. The camp, transportation, and mill facilities were used by COMINCO from 1951-1957 for the Tulsequah Chief mine, which is located directly across the Tulsequah River. SUNTAC negotiated an option agreement with property owner REMBRANDT GOLD MINES of Vancouver, B.C., in which SUNTAC can earn a 60-percent interest by spending Can\$3 million over 5 years. In summer 1988, a consultant to SUNTAC, using a minimum mine width of 5 ft and a cut-off grade of 0.15 oz/ton gold, estimated remaining reserves within the mine workings at 244,000 tons grading 0.33 oz/ton gold. Beginning in the fall of 1988, SUNTAC conducted a short, 3,500-ft surface core-drilling program, did geochemistry, and rehabilitated the AJ adit and some underground workings. Financing is underway for a major program of underground rehabilitation and underground drilling in 1989.

In the extreme northwest corner of British Columbia, GEDDES RESOURCES LTD. spent Can\$9.9 million (US\$8.4 million) on underground drilling and drifting to define a gold-bearing zone in the Windy Craggy copper-cobalt massive sulfide deposit (loc. 40, fig. 6). Current reserves are estimated at 95 million tons that grade 2.5 percent copper, 0.009 oz/ton gold, and 0.1 percent cobalt. The company also made a special submission to the British Columbia government for a proposed road route to develop the property.

## YUKON TERRITORY

The Division of Indian Affairs and Northern Development reports exploration expenditures of Can\$50 million (US\$42 million) during 1988 in

the Yukon Territory, an increase of about 20 percent from 1987 (Morison and others, 1989). There was an upturn in grassroots exploration programs, and 10,000 new quartz claims (lode claims) were staked, bringing the total number of active quartz claims in the territory to about 53,000. While interest was high in precious metals, there was also significant interest in exploration for copper, zinc, and nickel. More than 30 programs were reported.

Approximately 2,400 new placer claims were staked, bringing the total of active placer claims to about 17,000, while 308 new placer leases (similar to prospecting sites) were granted. During 1988, 31 individuals received funding under the Prospectors Assistance Program--which contributes up to Can\$5,500 for travel and operating expenses to qualified individuals.

During 1988, six placer projects and 29 hard-rock projects qualified for funding, a total of Can\$1.0 million,

under the Exploration Incentives Program--which provides a 25-percent rebate of eligible expenses for approved exploration projects in the Yukon. The Yukon government has contributed Can\$3.4 million over the last 3 years to these two incentive programs.

## MINERAL DEVELOPMENT DURING 1988

### INTRODUCTION

Mineral development expenditures in Alaska totaled \$275 million in 1988, more than doubling 1987 development expenditures (table 6). The 1988 figure is the largest ever recorded in Alaska and is almost totally made up of capital costs for the development of the Red Dog and Greens Creek mines. Both mines experienced peak construction activity and capital investment during 1988. Greens Creek will begin production in early 1989, and Red Dog will complete construction and begin production in early 1990. At present, there are no comparable projects scheduled to begin in 1989. Therefore, development expenditures will decline in 1989 and, unless other major mining properties begin construction in 1990, will continue to decrease.

The expenditures tabulated for this section represent capital invest-

ments made for construction of new mines or for the expansion or further development of existing mines. If a final decision has been made to bring a project to the production stage, the costs of environmental studies, permitting, marketing, and on-site property improvements have been included in this section as development expenditures. However, for the purposes of this report, when these activities and improvements have been done in the absence of a construction decision, the costs have generally been tabulated as exploration expenditures.

In general, placer mines develop new mine pits or cuts on an annual or even biannual basis and generally do not report these activities as development expenditures. When they have been reported, and when expenditures for the development of new placer mines or for the relocation of existing

placer mine operations have been reported, they have been included in the figures for placer projects statewide contained in this section.

Locations of selected development projects are shown in figure 16.

### RED DOG PROJECT COMINCO/NANA Northern region

Construction activities during 1988 brought the Red Dog project to 60 percent completion (locs. 1 and 2, fig. 16). The mine is expected to begin producing concentrates in early 1990, with its first shipments from the project's port site to begin during the summer months of that year. The total development cost for the project is estimated at \$420 million. When the mine reaches full production, the project will employ about 300 persons.

Table 6. Mineral-development expenditures in Alaska by commodity, 1982-88

	1982	1983	1984	1985	1986	1987	1988
Base metals	\$10,270,000	\$19,500,000	\$10,710,500	\$13,000,000	\$7,260,800	\$62,080,000	\$200,000,000
Precious metals	19,320,000	7,112,500	15,058,555	16,890,755	16,417,172	37,640,848	74,945,400
Industrial minerals	4,251,000	1,000,000	579,000	1,830,000	124,000	188,000	--
Coal and peat	7,750,000	250,000	27,000,000	2,400,000	530,000	342,000	--
<b>TOTAL</b>	<b>\$41,591,000</b>	<b>\$27,862,500</b>	<b>\$53,348,055</b>	<b>\$34,120,755</b>	<b>\$24,331,972</b>	<b>\$100,250,848</b>	<b>\$274,945,400</b>

-- = No expenditures reported.

During the 1988 construction season, an estimated 1,000 persons were employed by contractors working on the road, port facilities, and mine site, 40 percent of which were regional area residents. The total number of employment positions filled by contractors during the course of the year totaled over 1,400, though many persons filled multiple positions as contracts were completed and new contracts begun. Estimated development expenditures during 1988 were \$200 million.

The Red Dog deposit is owned by the NANA REGIONAL CORP., an Alaska Native corporation headquartered in Kotzebue, in northwest Alaska. The Red Dog mine is being constructed and will be operated by COMINCO ALASKA INCORPORATED (COMINCO) of Anchorage. The deposit is located 700 miles northwest of Anchorage and 90 miles north of Kotzebue, in the De Long

Mountains (loc. 1, fig. 16). The announced reserves at the deposit are 85 million tons grading 17.1 percent zinc, 5 percent lead, and 2.4 oz/ton silver. The mine life, predicated on this reserve base, is estimated to be 50 years. In addition to the sulfide ore reserves delineated in the main pit area, there is a zone of oxidized material south of the main deposit and there are unquantified tonnages of sulfide material north of the main pit.

Development of the Red Dog mine began in 1986 with the initial construction of a shallow water dock at the project's port site about 15 miles south of Kivalina on the Chukchi Sea (loc. 2, fig. 16). In 1987, a 2.3-million-gallon fuel tank was installed at the port site and a 52-mile pioneer road was constructed from the port site to the mine site by ENSERCH ALASKA CONSTRUCTION, INC. (ENSERCH). ENSERCH averaged a rate of 100 ft/hr at 20 hr/day in completing

the initial lift for the pioneer road. Additionally, a construction camp was erected near the mine site by GREEN CONSTRUCTION COMPANY.

During 1988, ENSERCH completed the road to its final design specifications. The completed road is 30 ft wide with 300-ft-long passing turnouts at 2-mile intervals, has a minimum fill depth of 4 ft, and is underlain by a woven geotextile fabric. The road has 13 major stream crossings with nine bridges. Four bridges were constructed using backfilled sheetpile abutments while five used conventional benched rip-rap design. In addition to the nine bridges, the road contains four major culverts and some 450 minor culverts. ENSERCH demobilized its equipment in October 1988.

Construction activities at the port site during 1988 included installation of three additional 2.35-million-gallon, double-walled fuel tanks (for a total capacity of 9.4 million gallons); initial construction of a 1,450-ft-long, 10-story-high concentrate storage shed capable of holding 500,000 tons (9-10 months of mine production); and construction of two offshore, rock-filled conveyor pier supports (fig. 17). A concentrate storage structure will be built in 1989 by GARCO, INC., of Spokane. When in operation, concentrates will be hauled from the mill site to the port storage facility year-round, except during periods when migrating caribou cross the road. A contract has been let to ARROW TRANSPORT who will use a fleet of six 72-ton trucks to transport 750,000 tons of concentrate to the port annually. During the 90- to 110-day ice-free shipping window, concentrates will be loaded from the concentrate storage building onto a conveyor belt, using front end loaders, and conveyed at a rate of 2,000 ton/hr to lightering barges in 15-20 ft water, 750 ft offshore. The 5,000-ton-capacity barges, which are equipped with ship loaders, will be towed 3 miles offshore to 50-ft depths, where ships of 25,000- to 60,000-ton capacities will be loaded.

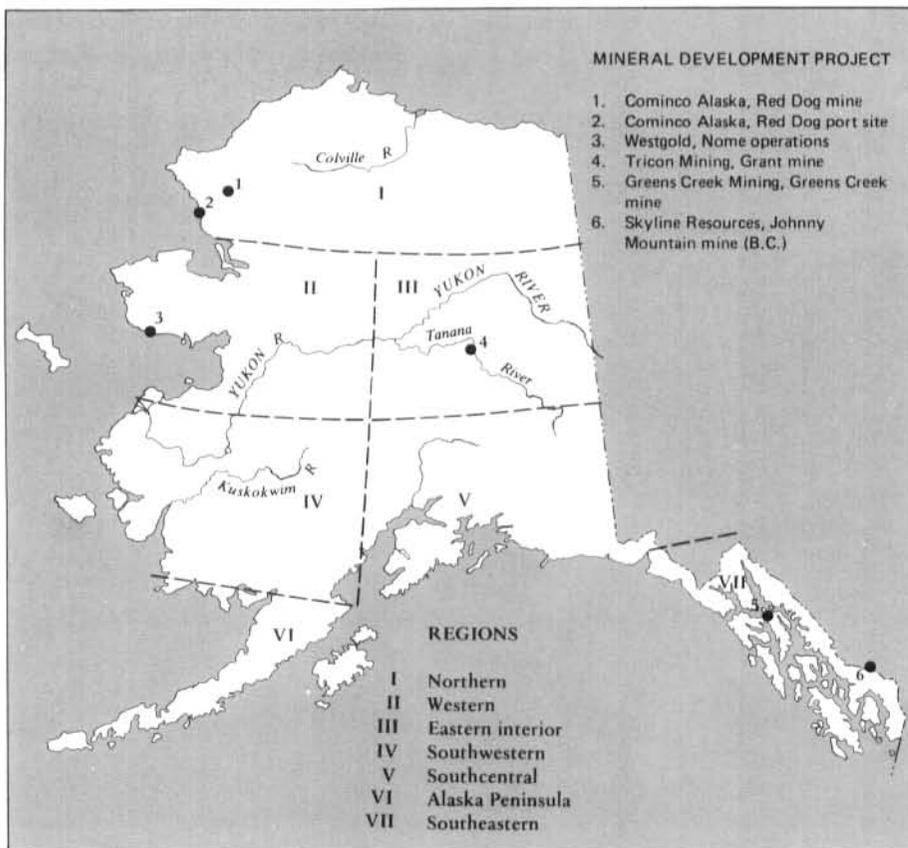


Figure 16. Selected mineral development projects in Alaska, 1988.



Figure 17. The fuel storage tanks and concentrate storage shed (under construction) for the Red Dog mine are located at the project port site near Kivalina on the Chukchi Sea. Photograph by Rob Stapleton, courtesy of Cominco Alaska Inc., 1988.

To prepare for mine startup in 1990, some 2.5 million tons of overburden are being stripped from the orebody, which is 4,400 ft long and up to 500 ft thick. The stripping ratio will average 0.9:1 over the life of the mine. Overburden and waste from the pit will be stored in three locations: in an overburden stockpile area, in an oxide ore stockpile, and in a marginal sulfide ore stockpile. The mine plan calls for use of four 85-ton ore hauling trucks, two front-end loaders, two blast-hole drills, two tracked dozers, a wheel dozer and a road grader. After the eighth year of production, the pit will cross Red Dog Creek, which will be diverted through a 2,200-ft tunnel. Using material stripped from the mine site, a 65-ft-high earthen tailings dam was constructed. The dam will be raised to a final height of 150 ft during the production phase. Work is scheduled to begin on a small dam at nearby Bons Creek in 1989 to supply fresh water to the services complex and concentrator. Construction of water lines is underway. A fresh-water tank and two 200,000-gallon fuel stor-

age tanks were erected at the mine in 1988.



Figure 18. A surveyor works on construction of mine facilities at the Red Dog mine site. Photograph by Rob Stapleton, courtesy of Cominco Alaska Inc., 1988.

Buildings at the mine site will consist of a services complex, worker accommodations, the concentrator mill, and a concentrate storage shed (figs. 18 and 19). The steel-framed services complex will house offices, a warehouse, and a maintenance shop. The accommodations complex will house up to 300 workers and contain food service and recreational facilities including a gymnasium. The building consists of 290 modules which were fabricated in Boise, Idaho, and shipped to the port. The assembly of the modules was completed in December 1988. The foundation for the 6,000 ton/day concentrator mill was completed during the summer. At the mill site, which is located in an area of permafrost, the initial foundation design was partially modified when the excavation of the area uncovered less stable rock than anticipated. Eleven mill modules weighing between 800 and 1,800 tons are being constructed in the Philippines. They will be shipped to Dutch Harbor during summer 1989, transferred to barges for the shallow

water trip to the port, offloaded onto self-propelled crawlers, and transported to the mine site. The modules are up to 120 ft long and 75 ft wide.

The concentrator mill will produce an estimated 750,000 tons of concentrate annually: 580,000 tons of zinc concentrate, 120,000 tons of lead concentrate, and 50,000 tons of concentrate suitable for feed into an Imperial smelter furnace. The mine will ship 50 percent of the concentrate production to COMINCO's zinc-lead smelter in Trail, British Columbia, while the balance of the concentrate will be split between smelters in Europe and the Far East.

Construction of mine site and mill facilities is being financed by a consortium of Swiss, German, and Australian banks which have made a \$200 million construction loan and a \$100 million revolving working capital loan to COMINCO. The construction of the road and port site facilities is being financed by the ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY (AIDEA). To finance and develop the system, known as the De Long Mountains Transportation System, the 1985 state legislature authorized AIDEA to issue up to \$175 million in bonds. The agreement between AIDEA and COMINCO requires the state receive

a 6.5-percent return on investment. COMINCO will begin making annual payments of approximately \$12 million in 1990. COMINCO will also pay for annual port and road maintenance.

### **TRICON MINING PROJECT** **Fairbanks mining district** **Eastern interior region**

TRICON MINING, INC. (TRICON), developed a new mining pit and constructed new sections of road on the company's Grant mine properties near Fairbanks (loc. 4, fig. 16). In anticipation of exhausting open-pittable ore at the mine's Ethel and Elmes ore zones, TRICON pre-



*Figure 19. A bird's eye view of the Red Dog office, warehouse and maintenance complex (foreground), accommodations building (background), and tailings thickener tank (adjacent to the accommodations building). Photograph by Rob Stapleton, courtesy of Cominco Alaska Inc., 1988.*

pared the Silver Dollar vein system for mining in 1988. The company stripped, trenched and did detail drilling on the vein system, constructed a 4,500-ft access road to the vein, and constructed a quarter mile of new road at the mill site. The Silver Dollar vein is located on the south flank of Ester Dome near Ready Bullion Creek, and ore from the vein is hauled by end-dump trucks over public highways to the mill site on the east flank of Ester Dome. TRICON constructed a quarter-mile section of access road over company held mining claims to reroute ore trucks off a narrow and winding section of public road directly to the primary crusher at the mill site. The road was completed in midsummer and the mill began processing ore from the Silver Dollar pit in October, 1988.

## PLACER PROJECTS STATEWIDE

Placer project development expenditures reported by 14 placer operations during 1988 totaled \$5.8 million (table 7).

In the northern region, PARADISE VALLEY MINING constructed housing and worked on the property's roads, trails, and airstrip. The project operates a placer mine and also hosts tourists and recreational miners.

In the western region, WESTGOLD carried out an extensive program of development drilling and bulk sampling on the company's offshore state mining leases near Nome (loc. 3, fig. 16). WESTGOLD uses a hammer drill operating on ice during winter

months and on a drill ship during summer months. The company also tested an experimental drill in a contract with the University of Mississippi.

Also near Nome, the ALASKA GOLD COMPANY carried out an extensive development drilling and stripping program to prepare frozen gravels for summer mining by the company's two onshore bucketline dredges.

GREEN MINING AND EXPLORATION built 2,200 ft of road at Long Creek in the Ruby mining district to bypass traffic around areas to be mined in the next 3 years. THURMAN OIL & MINING mobilized mining equipment from Nome to Canyon Creek in the Council mining district and did extensive backhoe and dozer work in preparation for startup of mining in 1989. Homer Hoogendorn of BUSTER CREEK MINING reported stripping operations at the Buster Creek property in the Cape Nome district.

In the eastern interior region, WILLFORD MINING conducted clearing and overburden stripping, and constructed settling ponds on the company's Hoosier Creek claim in the Rampart mining district. SHOREHAM RESOURCES stripped overburden and undertook development of a gold-tin placer operation on Tofty Mountain in the Hot Springs mining district. The company will begin production in 1989 and, in addition to placer gold and silver, the operators anticipate significant cassiterite (tin) recovery. On Pearl Creek in the Fairbanks mining district, WALTER ROMAN stripped overburden on

placer claims in preparation for mining in 1989. DOUBLE JACK MINING (TED BOTNAN) continued development work and drove 100 ft of drift at the Reading mine property on Treasure Creek near Fairbanks. The company is evaluating underground drift mining techniques for placing the claims into production. The company has been using drilling and blasting to loosen the frozen gravels and plans to invest in articulated rubber-tired trucks and loaders to load and haul material to the surface. Also in the eastern interior region, GREENHORN MINING and DISCOVERY MINING stripped overburden in the Circle mining district. In the Fortymile mining district, 45 PUP MINING stripped approximately 30,000 ft<sup>2</sup> in preparation for mining in 1989.

In the southwestern region, LYMAN RESOURCES stripped overburden and mobilized equipment in the Iditarod mining district. DAVE PENZ relocated his family placer operation near Russian Mission, excavated a new drain, set up a new jig recovery plant, and anticipates production in 1989.

In the southcentral region, GOLD DUST MINING constructed settling ponds and stream bypasses in the Chistochina mining district to prepare for mining in the 1988 season. ARNOLD AND SALLY ECHOLA stripped overburden on Gold and Wickersham Creeks on ground south of the Denali Highway.

In the southeastern region, JOHN SCHNABEL constructed an access road to the Big Nugget Mine on Porcupine Creek in the Haines mining district.

## GREENS CREEK PROJECT BP MINERALS Southeastern region

The Greens Creek project, located 18 miles west of Juneau on Admiralty Island, continued mine construction in 1988 and begins initial concentrate production in early 1989 (loc. 5, fig. 16). Greens Creek will be-

Table 7. Reported placer gold development expenditures in Alaska by region, 1988

Region	Number of operators	Expenditures
Western	5	\$5,288,000
Eastern interior	4	343,400
All other areas	5	154,000
TOTAL	14	\$5,785,400

come the first major hard-rock producer in Alaska in over four decades. The joint venture operation is managed by the GREENS CREEK MINING COMPANY, a subsidiary of BP MINERALS AMERICA. Joint venture partners include BP MINERALS AMERICA (53.1 percent), HECLA MINING (28.0 percent), CSX OIL AND GAS CORPORATION (12.6 percent), and EXALAS RESOURCES (6.3 percent).

The Greens Creek mine has been designed to produce 1,000 ton/day for 355 day/yr, predominantly from drift-and-fill mining techniques, with cut-and-fill techniques used in steeply dipping areas of the orebody. At full production, yearly mine output is expected to be 85,000 tons of concentrates containing 6.4 million oz of silver, 36,000 oz of gold, 24,800 tons of zinc, and 9,000 tons of lead. At this production rate, Greens Creek will become one of the largest producers of silver in the United States. Indicated reserves at the mine total 3.5 million tons averaging 23.8 oz/ton silver, 0.18 oz/ton gold, 9.7 percent zinc, and 3.9 percent lead and are open at depth. At a production rate of 355,000 ton/year, mine life is estimated to exceed 10 years. The prospects for discovering additional tonnages of ore in the Greens Creek area are considered good. Development at the mine site began in 1986 with completion of a 9-mile road from the Hawk Inlet dock site to the mine on upper Greens Creek. In 1987, a new portal was collared, and drifting began on an adit which will serve as the main ore haulageway. A 5-mile 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 will ferry mine workers from Juneau.

In 1988, a 1,000 ton/day concentrating mill was constructed (fig. 20) which will process minus-18-inch ore from the mine. The mill's grinding circuit will use a combination of a semi-autogenous grinding mill and a ball

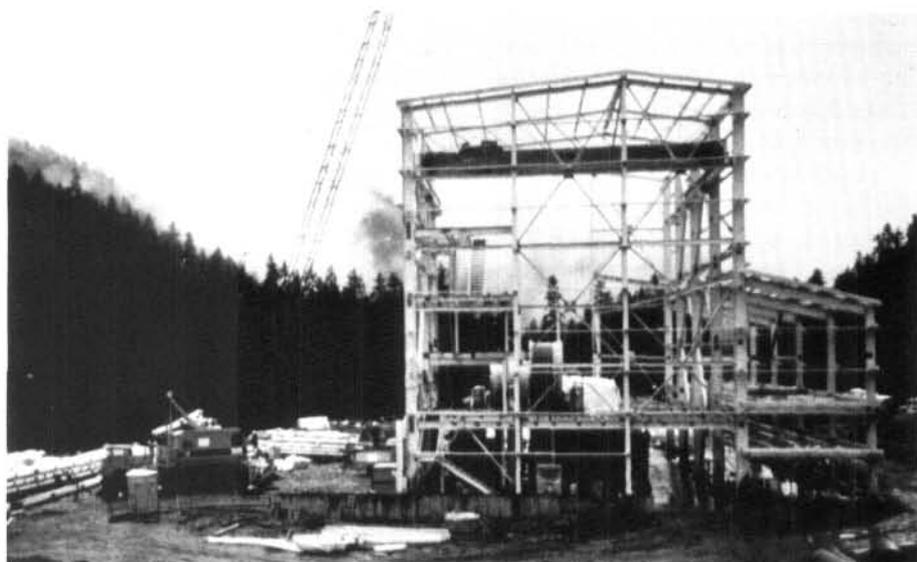


Figure 20. The Greens Creek mill and concentrator was under construction in June. Photograph by Al Clough, 1988.

mill. A gravity concentration circuit will recover coarse free gold and feed a flotation circuit that will produce zinc, lead, and bulk metal concentrates. The concentrates will be trucked from the mill site to the Hawk Inlet dock (fig. 21) for ocean shipment to smelters in England, Belgium, Italy,

France, Japan, and Korea. Also in 1988, an equipment maintenance workshop and a building to house mine office and worker changing facilities were constructed. Underground work during the year consisted of test-stoping and an extensive diamond-drilling program that provided



Figure 21. Site preparation at Hawk Inlet for the construction of the concentrate storage shed and ship loader was completed in September at the Greens Creek mine. Photograph by Ray Parker, courtesy of Greens Creek Mining Company, 1988.

detailed information for mine development plans. The mine will generate its own power and took delivery of three 2.2-megawatt generator sets in November 1988.

A 100-ft catamaran ferry with a capacity of 140-150 passengers was constructed by ALLEN MARINE WAYS of Sitka and delivered to the project in 1988. The catamaran will ferry mine workers on the 30-35 minute daily commute between Auke Bay near Juneau and Young Bay on Admiralty Island. Sitka schoolchildren named the catamaran the *Alaskan Dream*. A second smaller catamaran serves as a backup ferry.

In an effort to maximize local hire, GREENS CREEK and the University of Alaska Southeast organized training classes which were held throughout 1988. The training program is more thoroughly described in the Mining Education section of this report. Over 240 students completed the course and became eligible for entry level jobs at the mine. The curriculum for the training program was initially developed by the Mining and Petroleum Training Service of the University of Alaska Anchorage and further adapted in Juneau.

Total capital development costs for Greens Creek were near \$106 million. At full production, the mine will have a workforce of about 210 mine, mill, engineering, service and administration personnel. Direct income to the Juneau community in wages, salaries and benefits is estimated to be \$10 million annually.

## **NORTHWESTERN CANADIAN MINERAL DEVELOPMENTS THAT AFFECT ALASKA**

The Province of British Columbia reported a capital investment in 1988 of Can\$315 million (US\$268 million) for the development of new mines that either began production in 1988 or are scheduled to begin production in 1989 (Preto, 1989). It is estimated that the new mines will result in the creation of 1,100 new jobs. The accelerated exploration activities in recent years resulted in a record number of submissions for mine development approvals to the Province's Mine Development Review Process. During 1988, a total of 40 projects were under review, of which 32 were for precious metals. Included in the development expenditures are construction costs of Can\$23.5 million (US\$20 million) by SKYLINE EXPLORATIONS LTD. for the Johnny Mountain (Reg) mine in the Iskut River area near Wrangell, Alaska (loc. 6, fig. 16). The Johnny Mountain mine, an underground lode gold mine processing 200 ton/day of ore, began production in August 1988. At a second property adjacent to Johnny Mountain, the Snip deposit, operated by COMINCO LTD., development work is expected to begin in 1989 on a 500 ton/day underground gold mine (see Exploration section).

Additionally, WESTMIN RESOURCES LTD. (WESTMIN) began construction of its Silbak Premier-Big Missouri mine project at Stewart, B.C.,

near Hyder, Alaska (loc. 7, fig. 16). WESTMIN is scheduled to begin processing 2,200 tons of gold ore from two open pits in spring 1989. The development of the Johnny Mountain mine and the exploration activities at many other prospects in the Iskut River area of British Columbia have had a strong economic impact on the community of Wrangell, which has served as an airport staging and supply center. As a measure of the dramatic increase in activity, over 6,300 flights across the Canadian border from Wrangell were logged in 1988 versus 279 in 1985. The Wrangell airport was second only to Anchorage in total number of international flights. In 1988, estimated expenditures of US\$2 million for supplies and services significantly increased business activities in Wrangell and the region. Three new businesses were started in the city as a result of the mining activity: an electrical contractor, a fuel distributor, and a construction contractor. Additionally, a full-time U.S. Customs agent is now stationed in Wrangell to ease the transfer of personnel and materials between British Columbia and Alaska. Talks have begun between government representatives from Alaska and British Columbia to consider the construction of a road link from Alaska which would connect the Iskut River mining area to tidewater at the Bradfield Canal.

## **MINERAL PRODUCTION IN 1988**

### **INTRODUCTION**

The value of Alaska's mineral production in 1988 was \$232.2 million, up 15 percent from the 1987 figure of \$202.4 million (table 8). Production quantities and gross values for 1988 mineral commodities were: gold--265,500 oz worth \$112.8 million; sand and gravel--17.2 million tons worth

\$48.8 million; coal--1.55 million tons worth \$44.3 million; and stone--3.6 million tons worth \$24.7 million. These four commodities accounted for 99 percent of the total gross dollar value. Tin, mercury, silver, tungsten, jade, soapstone, and peat accounted for the remaining one percent. Princi-

pal metallic, nonmetallic, and coal mines and quarry locations are shown on figure 22.

Production estimates are based on data compiled from 229 questionnaires returned by mining companies, municipalities, and individuals; responses to a telephone survey of 35

Table 8. Reported mineral production in Alaska 1986-88<sup>a</sup>

Metals	Quantity			Estimated values <sup>b</sup>		
	1986	1987	1988	1986	1987	1988
Gold (oz)	160,000	229,700	265,500	\$ 60,800,000	\$104,516,230	\$112,837,000
Mercury (lb)	912	NR	W	2,800	NR	W
Antimony (lb)	45,000	NR	NR	67,500	NR	NR
Platinum (oz)	W	W	25	W	W	13,750
Silver (oz)	24,000	54,300	47,790	134,400	390,960	281,950
Tin (lb)	340,000	288,000	300,000	890,000	460,000	950,000
Tungsten (stu)	120	160	240	22,800	11,400	14,000
Subtotal				\$ 61,917,500	\$105,378,590	\$114,096,700
Industrial minerals, coal and peat						
Jade and soapstone (ton)	2.0	3.6	W	\$ 12,000	\$ 78,000	\$ W
Sand and gravel (mt)	20.9	16.7	17.2	75,761,507	42,659,808	48,750,500
Building stone (mt)	4.2	1.8	3.6	20,320,000	11,620,000	24,650,000
Subtotal				\$ 96,093,507	\$ 54,357,808	\$ 73,400,500
Coal (ton)	1,492,707	1,508,927	1,551,162	\$ 40,100,000	\$ 42,354,500	\$ 44,300,000
Peat (yd <sup>3</sup> )	50,000	46,000	55,000	350,000	299,000	375,000
Subtotal				\$ 40,450,000	\$ 42,653,500	\$ 44,675,000
TOTAL				\$198,461,007	\$202,389,898	\$232,172,200

<sup>a</sup>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.

<sup>b</sup>Values calculated from 1988 annual price averages of gold, silver, and platinum; other values directly supplied by mine operators. NR = not reported; W = withheld; mt = million ton; stu = short-ton unit.

companies and government agencies that mine or lease sand, gravel, and stone deposits; Alaska Division of Mining field notes on 1988 placer mining operations; and information provided by the U.S. Bureau of Mines, University of Alaska, Alaska Department of Transportation and Public Facilities (DOTPF), and precious-metal refiners. Historic production levels for gold, sand and gravel, and coal are displayed in figures 23, 24, and 25, respectively. Summaries of production estimates since 1880 for nine metals, three industrial minerals, and coal (apps. E and F) show that Alaska mineral production has been dominated by gold.

Alaska's mineral production remained stable and in some cases increased in 1988. After a serious de-

cline in value in 1987, Alaska's sand-and-gravel industry began to recover. Production increased to 17.2 million tons in 1988 from 16.7 million tons in 1987, and value increased to \$48.8 million from \$42.7 million in 1987. Construction projects in the northern region, mainly at the Red Dog Mine project, coupled with increased construction on hydroelectric dam, mine, and timber projects in the southcentral and southeastern regions, sustained the sand-and-gravel industry in 1988.

Mine construction in southeastern Alaska and work on the Bradley Lake hydroelectric project also bolstered building-stone demand. Quarry operations reported the largest production increase of the industrial minerals group in 1988.

Alaska tin production in 1988 was 300,000 lb, similar to mid-1980s production. All production came from the LOST RIVER MINING COMPANY's Cape Creek placer mine on the western tip of Seward Peninsula. Tin prices increased substantially from 1987, and the value of cassiterite (tin oxide) concentrate production increased more than 100 percent, to \$950,000. Modest amounts of tungsten, silver, and platinum were recovered as byproducts of placer mining operations in 1988.

USIBELLI COAL MINES, INC., reported a 3-percent (42,235-ton) increase in coal production in 1988, for a total of 1.55 million tons, prompted by increased sales to the KOREAN ELECTRIC POWER COMPANY in South Korea. Export shipments also

continued in 1988 to the Electric Power Development Corporation of Japan for combustion tests.

The 1988 survey estimates that 265,500 oz of gold and 47,790 oz of byproduct silver, valued at \$113.1 million, were recovered from 208 placer mines and three lode mines statewide (table 9). Gold production in 1988 increased 16 percent in volume and 8 percent in value over 1987.

As in the previous year, increased gold production was the result of expanded operations at several larger mines. Eight placer-mining companies--VALDEZ CREEK MINING COMPANY, WESTGOLD, ALASKA GOLD COMPANY, POLAR MINING, GHD RESOURCES, WINDFALL MINING, ANVIL MINING, and SPHINX AMERICA INC.--produced 142,940 oz of refined gold; and CITIGOLD ALASKA, INC., and TRICON MINING, INC., produced 13,515 oz of refined gold from 21,395 oz of gold-silver bullion at lode deposits on Ester Dome near Fairbanks. These ten operations produced 59 percent (156,455 oz) of total statewide gold output.

The significant increases in gold production in 1987 and in 1988 obscure the continuing legal and regulatory problems facing small Alaska placer mining companies. Between 1985 and 1986, the number of placer mines fell from 266 to 196, a 27-percent reduction. In 1988, 208 mechanized placer mines operated in Alaska, an increase which indicated that the industry has stabilized somewhat from the 1986 decline.

The average Alaska gold mine in 1988 produced 1,276 oz of gold and employed 7.5 individuals (compared to 1,120 oz and 6.2 employees in 1987, 820 oz and 5.9 employees in 1986, and 720 oz and 5.8 employees in 1985). Average gold production per employee was 203 oz in 1988, 178 oz in 1987, 139 oz in 1986, and 124 oz in 1985. These data suggest increasing efficiencies by the Alaska placer miner. However, when the lode operations on Ester Dome and four

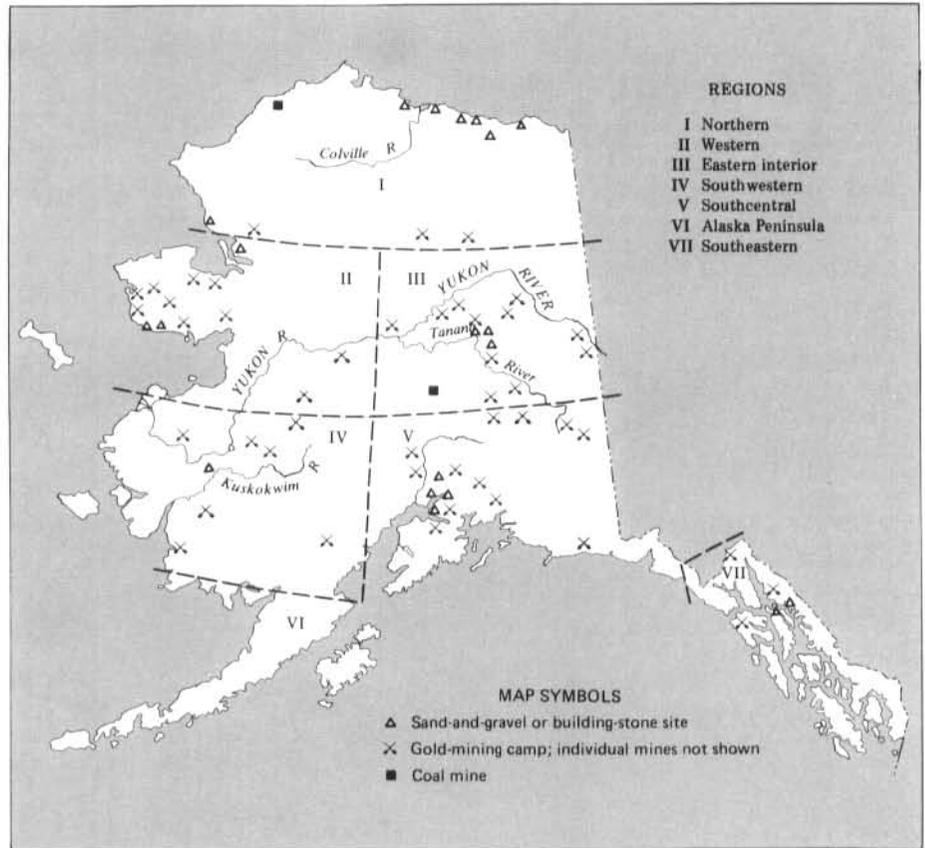


Figure 22. Location of principal gold mining camps, coal mines, and industrial mineral sites in Alaska, 1988.

large dredge and open cut mines in western and southcentral Alaska are subtracted, the average Alaska family-

operated placer mine produced 644 oz and employed 4.2 individuals, a slight decrease from 680 oz and 4.4

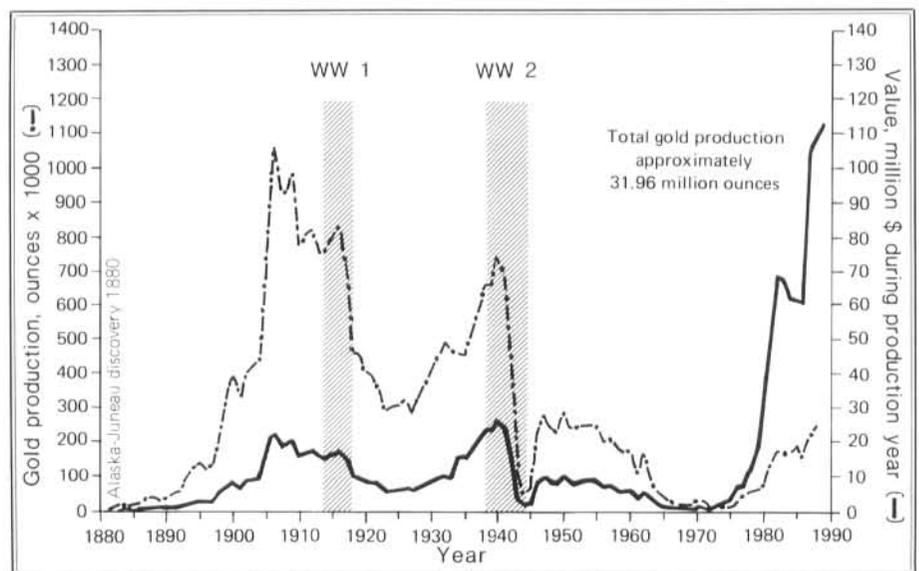


Figure 23. Gold production in Alaska, 1880-1988.

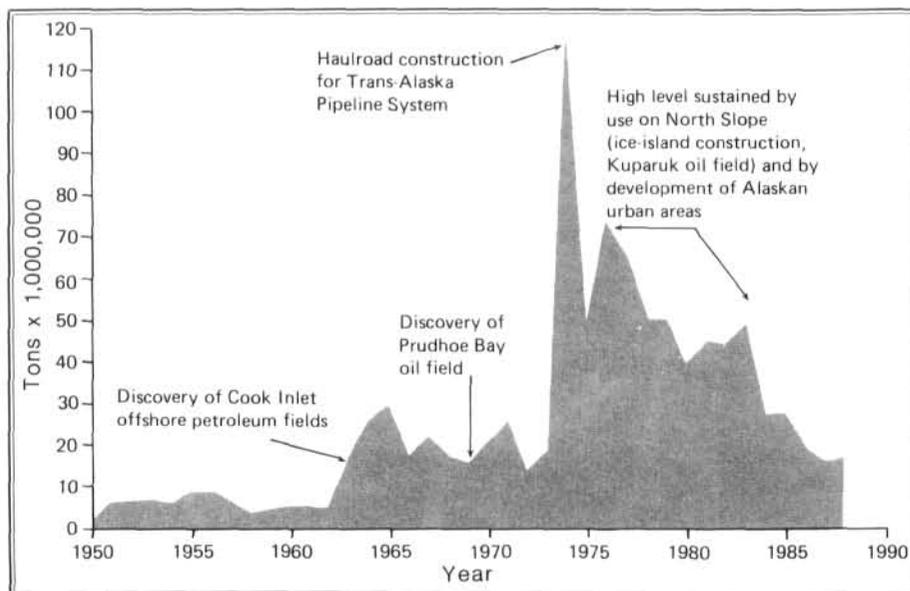


Figure 24. Sand and gravel production in Alaska, 1950-88.

individuals in 1987. These data compare closely to average production and employment data from Yukon Territory, Canada, where the average Yukon placer mine in 1987 and 1988 produced 660 oz and 740 oz and employed 3.8 and 4.0 individuals, respectively (Johnson, 1988; Morison and others, 1989).

An estimated 2,779 persons were employed in Alaska mines and

quarries in 1988. Placer mining employed 1,206 persons; lode mining, 99 persons; sand and gravel operations, 752 persons; building stone quarries, 210 persons; coal mining, 122 persons; tin, jade, and soapstone mining, 40 persons; and recreational mining enterprises, 350 persons. Employees at lode gold and coal mining operations generally work year-round. Employees at gold placers,

sand and gravel pits, stone quarries and other operations usually work on a seasonal basis (an average of 5-1/2 months/year). Coal production employment figures include only those at the mine site and not employees at the Alaska Railroad or the Sun Eel shipping terminal.

Several legal and governmental decisions affected Alaska's mineral industry in 1988. The U.S. Supreme Court declined to hear the State's appeal on the Alaska Supreme Court's 1987 interpretation of Section 6(i) of the Statehood Act. As a result, the Alaska State Legislature in 1989 will be amending certain state laws governing the location of state mining claims, and addressing the implementation of rental and royalty fees on state owned lands. Currently, 44,000 state mining claims are held by 2,300 individuals or companies, and one-fifth of the total gold produced in Alaska annually comes from state lands.

On May 24, 1988, the U.S. Environmental Protection Agency (EPA) issued placer mining effluent guidelines, which had been under study since 1986. The guidelines will be included in 1989 water discharge permits and require 100 percent recycling of mine process waters, place certain restrictions on the use of hydraulic mining technologies, and recommend certain 'best practice' mining methods. The U.S. Department of the Interior issued formal objections to parts of EPA's economic analysis prepared for the effluent guidelines, including requests that the average placer deposit grade (oz/yd<sup>3</sup>) be lowered and certain costs of required reclamation and recycling technologies be added.

EPA inspected 124 mine sites in 16 mining districts during the 1988 season and found that 85 were active. Of those mines actively sluicing, 46 percent had zero discharge and 95 percent met federal settleable solids criteria. Two hundred eight miners applied for and obtained turbidity-limit modifications in their 1988 NPDES permits. EPA uses effluent

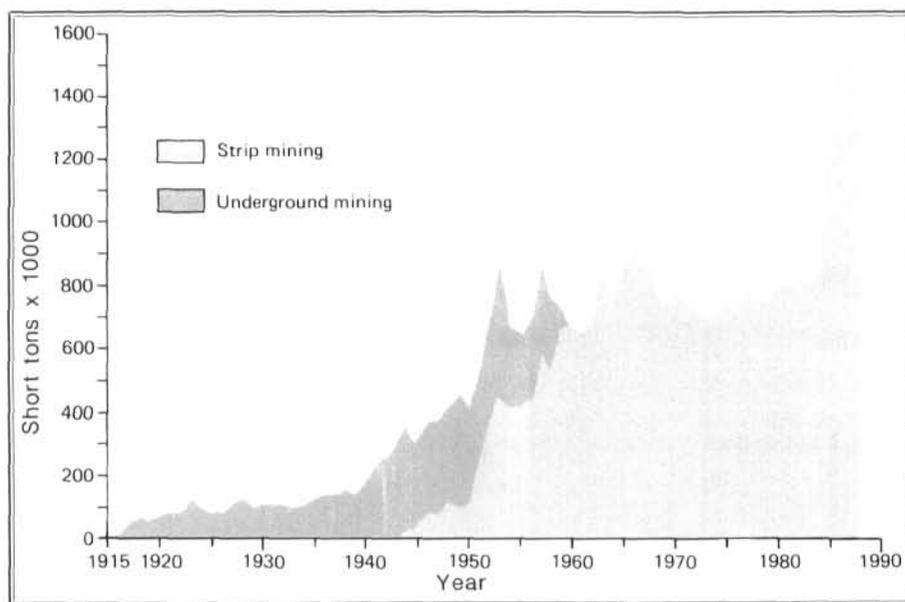


Figure 25. Coal production in Alaska, 1915-88.

Table 9. Reported refined gold production, number of operators, and industry employment in Alaska by region and mining district, 1987-88<sup>a</sup>

Region and mining district	1987			1988		
	Number of operators	Production (oz)	Number of employees	Number of operators	Production (oz)	Number of employees
Northern Chandalar Shungnak Koyukuk-Nolan	8	7,256	40	8	6,500	32
Western Nome Kougarok-Hughes Port Clarence Fairhaven Ruby Solomon Koyuk Council	46	101,244	414	48	98,500	425
Eastern interior Circle Livengood-Tolovana Fairbanks Fortymile Manley-Eureka Richardson Bonnifield Rampart	81	50,690	380	89	76,550	415
Southwestern Innoko-Tolstoi Iditarod-George River Moore Creek Nyac Crooked Creek Lake Clark-Mulchatna	36	20,650	129	33	14,800	108
Southcentral Cache Creek Chistochina Valdez Creek Kenai Peninsula Nelchina	29	46,460	251	30	68,300	315
Alaska Peninsula and Southeastern	<u>5</u>	<u>3,400</u>	<u>35</u>	<u>3</u>	<u>850</u>	<u>10</u>
TOTAL	205	229,700	1,249	211	265,500	1,305

<sup>a</sup>1988 production estimated from 208 mechanized placer mines and three lode mines statewide. Small 'recreational-assessment' projects that recover bullion from panning, pick-and-shovel prospecting, long-tom sluicing, and suction dredging are not included.

volume and receiving stream flow data provided by the DGGs hydrology laboratory to calculate a dilution ratio, which is then used to calculate a turbidity-limit modification in the NPDES permit.

The Alaska Department of Environmental Conservation (DEC) inspected 263 placer-mining sites in 1988, of which 158 (60 percent) were found to be active; 43 had no detectable water discharge, and 97 percent of the mines inspected met the federal settleable solids (0.2 ml/L) criteria. Turbidity measurements for 59 discharge sites fell within a 6-20 NTU (nephelometric turbidity unit) range. The results of DEC's inspections show marked and continuing improvements in downstream water quality. Hydrologic studies by Ray (1989) document lowered turbidity levels in Birch, Goldstream, and Faith Creeks in the eastern interior region (table 10).

The U.S. Bureau of Land Management (BLM) completed draft environmental impact statements (EIS) on the cumulative effects of placer mining within four interior Alaska drainage basins: Fortymile River, Birch Creek, Beaver Creek, and Chatanika River. The EIS's were required by a federal court order which also enjoined operating mines from disturbing more than 5 acres annually. In late 1988, the first of the final EIS's concerning Beaver Creek identified a preferred alternative that permitted

placer mining to continue under management policies adopted in 1987.

In a related action, the Canadian government, after years of research, decided in 1988 to adopt a classification system for streams in neighboring Yukon Territory that would apply the strictest water quality standards to streams which contain anadromous fish species and the least strict water quality standards to streams where historic placer-mining activity has taken place and where fish habitat will not be endangered (Staff, 1988).

A 1985 federal court injunction in the *Sierra Club vs. National Park Service* lawsuit has halted mining in Alaska's national parks for 3 years and will continue in effect until the National Park Service (NPS) completes several EIS's. The U.S. District Court prohibited NPS from issuing plans of operation to 30 mining operations in four national conservation units: 17 in Denali National Park and Preserve; 4 in Wrangell-St. Elias National Park and Preserve; 3 in Yukon-Charley River National Preserve; and 6 in Bering Land Bridge National Park and Preserve. The NPS is expected to issue the EIS's on mining in Alaska's national parks in spring 1989.

In 1988, the U.S. Army Corps of Engineers (Corps) began requiring permits under Section 404 of the Clean Water Act for placer mining activities that impact wetlands. Mining operations fell under three categories: those

which required individual permits, those which qualified for standard 'nationwide permits,' and those which were determined not to need wetlands permits. Wetlands permits issued by the Corps to placer miners included stipulations for land reclamation, stream reconstruction, settling pond design, and location of road and mine facilities.

In 1987, the U.S. Minerals Management Service initiated procedures to hold a lease sale for offshore mining of placer gold and other minerals on submerged federal lands in Norton Sound. The proposed federal lease tracts are located adjacent to state waters where WESTGOLD operates an offshore bucket-line dredge. The draft EIS for the lease sale was completed in November 1988, and the preferred alternative identified 178,282 acres of 350,000 acres originally proposed for leasing. Consideration of subsistence use areas and other environmental factors decreased the original total acreage offered in the lease proposal. The final EIS is expected in May 1989, and a final lease sale is scheduled for January 1990.

The EIS for the lease sale identified the potential for mercury bioaccumulation in the food chain. Mercury occurs naturally in the Nome mining district in the form of cinnabar, and mercury was widely used in early Nome placer operations for amalgamation of gold-silver bullion. Environmental monitoring of the WESTGOLD operation has not indicated that mercury is being bioaccumulated in the environment. However, because subsistence residents consume large amounts of seafood which naturally contains high levels of mercury, the EIS suggests that surveys be made to determine if present levels of mercury in residents require special action.

Sampling for metal contamination was carried out at the port of Skagway in southeastern Alaska, where CURRAGH RESOURCES

Table 10. Seasonal median turbidity from selected placer streams in interior Alaska<sup>a</sup>

Site	Turbidity <sup>b</sup>			1988
	1985	1986	1987	
Birch Creek at Steese Highway Bridge	25	23	18	7.1
Birch Creek above 12 Mile Bridge	-	230	150	91
Faith Creek at Steese Highway	-	31	14	5.9
Goldstream Creek at Ballaine Road	-	-	170	67
Goldstream Creek at Minto Flats	-	-	6.2	20

<sup>a</sup>Modified from Ray (1989).

<sup>b</sup>Values shown in NTU (nephelometric turbidity units).

(CURRAGH) ships lead-zinc-silver concentrates from the Anvil Mine in central Yukon Territory. Past operators of the Anvil mine shipped concentrates from Skagway to overseas refineries from 1969 to 1982, and CURRAGH resumed shipments in 1986. Anomalous levels of metals in sulfide form were found in samples collected by government agencies and consultants for CURRAGH at loading facilities in Skagway harbor. CURRAGH has modified the loading and shipping facilities to eliminate future contamination. Initial testing of Skagway residents did not reveal elevated metal levels. The need for remedial actions, including harbor dredging, is under discussion by CURRAGH and government agencies.

In August 1988, the Alaska Science and Engineering Advisory Commission within the Office of the Governor sponsored a conference in Fairbanks on Alaska rare earth element (REE) resources. REE's are used in a variety of high technology applications. The recommendation of the Commission was that DGGs and DOM, in cooperation with other state and federal agencies, conduct field studies to delineate resources and that the University of Alaska MRL develop laboratory techniques for the assaying and refining of the complex REE ore minerals (Cole, 1988).

## METALS

### NORTHERN REGION

Eight mining companies in the Koyukuk-Nolan, Wild Lake, Chandalar, and Shungnak districts produced an estimated 6,500 oz of gold in 1988, compared to eight mines and 7,260 oz in 1987. Although the number of reported mines increased, the Koyukuk-Nolan (or Wiseman) area suffered a severe drought, which caused water shortages and reduced production, especially for those with no water recycling system in place. Most of the gold mined in the northern region is from the Wiseman area. Five of eight

operations recycled 100 percent of mine process waters in 1988.

ALMINCO INC. leased the Eldorado claim group from the MAS-COT MINING COMPANY on the Hammond River near Wiseman and prepared for additional open-cut placer mining in 1989. REGINALD KAKOVICH worked small, rich pay zones on Bear and Eagle Creeks on the South Fork, Koyukuk River, and is designing a 150-200 yd<sup>3</sup>/day operation for the 1989 field season. PAUL DIONNE worked Mays' Bench on Nolan Creek and recycled mine process water by pumping 300 vertical ft from ponds using pumps in double series. TOM BRYANT and SAM MUNJAR also mined separate pay streaks on the Hammond River and recycled process water. Other operators in the Wiseman area include BILL FICKES on Boulder Creek, WILLIAM NORDEEN on Emma Creek, and the CHAFFIN and BUCHHOLZ operations on the South Fork, Koyukuk River.

PARADISE VALLEY MINING COMPANY again operated a combined placer mine and recreational mining camp at Birch Creek near Wild Lake in the Wiseman Quadrangle. The company used a dozer and standard sluicing equipment for its mechanized placer mine, while the recreational venture provided 'shovel-in' sluice boxes, gold pans, and metal detectors for clients. The value of the tourist venture in 1988 exceeded the gross production value from the mechanized mine.

TOBIN CREEK MINING COMPANY worked placers on Tobin Creek in the Chandalar mining district, east of the trans-Alaska pipeline.

### WESTERN REGION

Gold, silver and tin production from the western region in 1988 was similar to that of 1987. This region, which became the state's largest gold producer in 1987, continued to lead statewide gold production in 1988. An estimated 48 mine operators produced

98,500 oz of gold and 14,000 oz of byproduct silver during 1988, compared to 101,204 oz of gold and 18,000 oz of silver produced in 1987. About two-thirds of the production was from placer mines in the Nome district.

The largest producer in the region for the second consecutive year was the offshore dredging operation of WESTGOLD INC. In 1988 the 'Bima' offshore dredge operated from June 10 to November 14 and produced 35,500 oz of refined gold, nearly the same as in 1987 (fig. 26). WESTGOLD processed 2.9 million yd<sup>3</sup> of pay at an overall grade of 0.012 oz/yd<sup>3</sup> (comparable to recovery grades from strandline deposits mined onshore by ALASKA GOLD COMPANY). WESTGOLD, Alaska's second highest gold producer in 1988, operated the dredge at 78-percent efficiency on its 21,000 acres of state leases. The offshore dredge, 'Bima,' was originally built to process placer tin in Malaysia. The name 'Bima' was not, as previously reported, taken after 'a Malaysian goddess of fortune,' but rather is an acronym for the company for which it was built: *B*illiton *M*ining *A*ssociation (a subsidiary of the Royal Dutch Shell Group). WESTGOLD employed 108 people during the production season and retained 40 employees for the 1988-89 winter maintenance and exploration work. As in 1987, the company constructed an artificial ice ridge around the winter docking area of the 'Bima' on the Nome city causeway, in order to protect the dredge from movement of the Norton Sound pack ice (fig. 27). SIT-NASUAK NATIVE CORPORATION provides coordination services to WESTGOLD for employment of regional residents.

The ALASKA GOLD COMPANY again operated two floating, Yuba class, bucket-line stacker dredges in the Nome district and processed 1,594,000 yd<sup>3</sup> of pay gravels during the 1988 season. The company reported an operating profit of about \$3 million for the year. Dredge No. 6

operated about 1-1/2 miles west of the Nome airport; dredge No. 5 operated on the '3rd' ('Monroe') beachline near the southern flank of Anvil Mountain (fig. 28). Both dredges have 9-ft<sup>3</sup> buckets with maximum capacities of approximately 8,000 yds<sup>3</sup>/day. The dredges operated at 80- to 85-percent efficiency during 1988 (fig. 29). ALASKA GOLD initiated a mechanized winter stripping operation that first removes muck and gravel overburden from pay streaks and then uses cold water to thaw the pay (fig. 30). Because the dredges previously had to process the barren gravels which overlay the pay zone, the stripping of lower grade overburden in future years should increase production efficiency.

WINDFALL GOLD MINING CORPORATION again leased ground from ALASKA GOLD COMPANY and employed 34 miners to process 910,000 yd<sup>3</sup> from Cooper Gulch at the base of Anvil Mountain (figs. 31 and 32). Over the last 5 years, WINDFALL has been working a section of the pay zone near Anvil Mountain which ALASKA GOLD's dredge No. 3 had opened up in an east-west cut during the 1940s and 50s. WINDFALL reported that they had largely exhausted the Cooper Gulch pay zone in 1988 and have been looking for additional ground to mine for the 1989 season. WINDFALL reclaimed about 30 acres of formerly mined ground, which was seeded and contoured during the 1987-88 season. ANVIL MINING employed 15 people and operated a large-scale open-cut placer mine similar to WINDFALL's operation, about 2 miles east.

Several small operations processed pay gravel in the Nome district. BUSTER CREEK MINING stripped and processed pay zones on Buster Creek north of Nome. ENGSTROM DREDGING COMPANY operated a 1-1/2-ft<sup>3</sup> bucket-line stacker dredge on Basin Creek and produced byproduct gravel on patented mining claims in the area. KEN KRISTIANSEN operated a suction dredge on Hobson

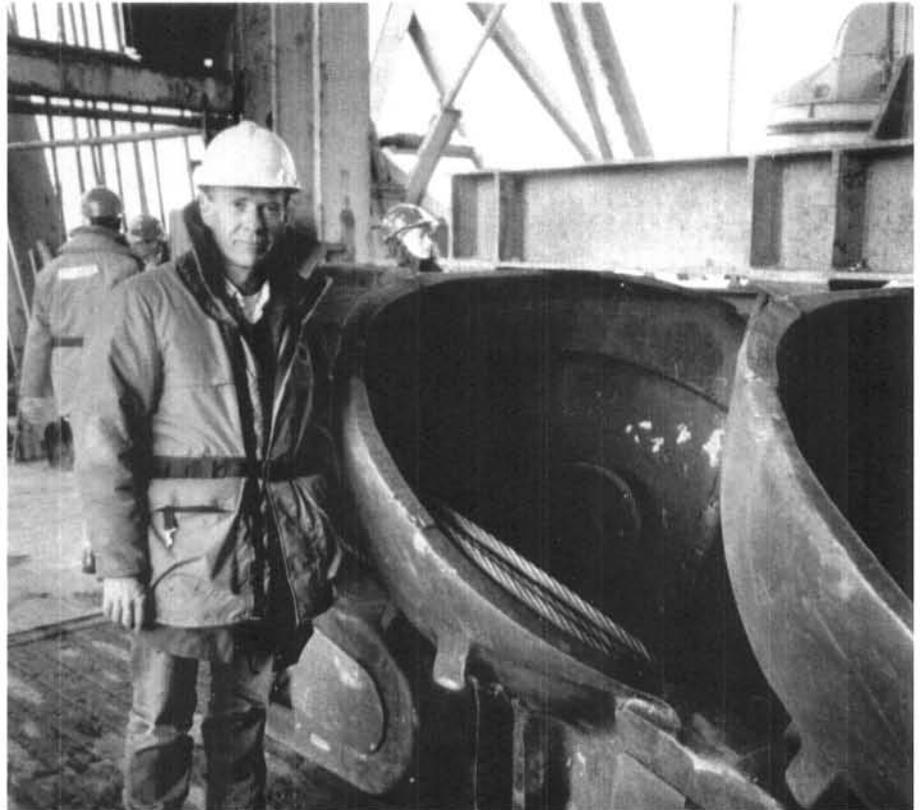


Figure 26. Jo Drechsler stands by spare digging buckets on Westgold's offshore placer dredge, the Bima, at Nome. Photograph by C.B. Green, 1988.

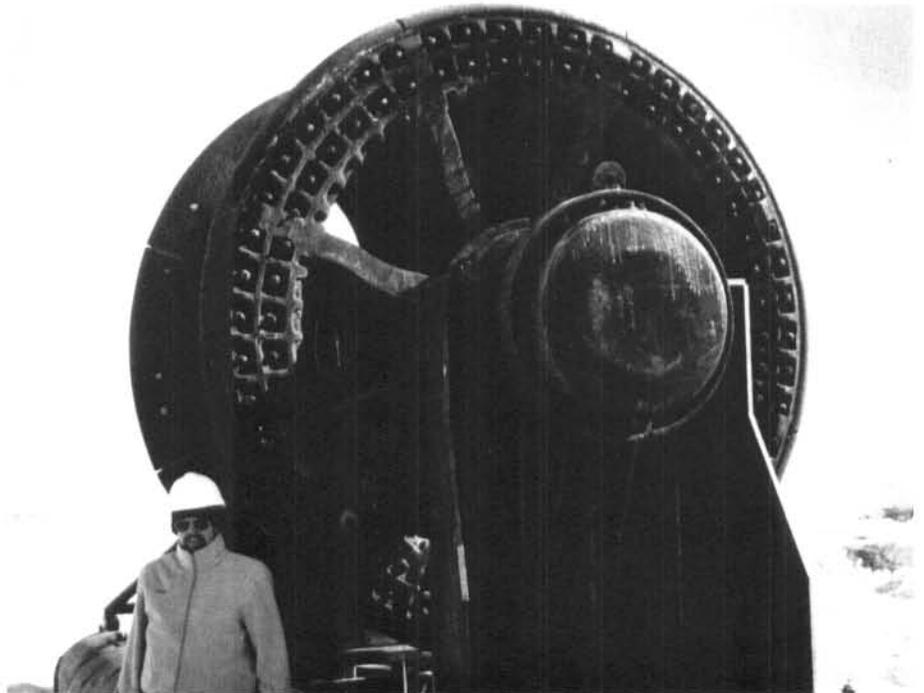


Figure 27. A replacement idler wheel from the bucket ladder of Westgold's offshore dredge dwarfs a chilled bureaucrat. Photograph by T.K. Bundtzen, 1988.

Creek, and TOM JOHNSON mined a small cut on Sweepstakes Creek.

Other open-cut placer mines that operated on the Seward Peninsula were: MULLIKON on Boulder Creek, MATHISEN on Sherrette Creek, WESTERN ARCTIC MINING on Dome Creek, TRINITY MINING on Washington Creek, UPCHURCH INC. on Kugruk River, OLSON on Candle Creek, CLARA BEA INC. on Kiwalik River, MEYERS on Mud Creek, HANSEN on Quartz Creek, and the GUMAER-GEBHARD PARTNERSHIP on Dick Creek. N.B. TWEET AND SONS again operated a 2-ft<sup>3</sup> floating dredge on the Kougarok River.

Larger open-cut operations were concentrated in the Candle and Fairhaven mining districts. Several had

been previously active in the eastern interior region. BEEHIVE MINING operated a large sluicing plant on Bear Creek in the Candle district and em-

ployed nine miners and camp help. BERG-WETLESEN COMPANY, GHD RESOURCES, and AU MINING COMPANY mined on the Clara



Figure 28. Shismaref resident Steve Weyiounna works as a winchman during the summer season on Alaska Gold's dredge No. 5 in Nome. Photograph by C.B. Green, 1988.



Figure 29. An aerial view of Alaska Gold's dredge No. 5 working in its pond (foreground), and of the adjacent thaw field where ground partially stripped during the winter is being prepared for mining in 1989. Photograph by Bruce Campbell, 1988.



Figure 30. Laborers work on thaw pipes which cycle water to bedrock where it percolates upward, thawing the frozen gravels for dredging. Photograph by C.B. Green, 1988.

Beatrice claim group in the Kiwalik River drainage and employed 19 persons as miners, equipment operators, and camp hands. GHD, the principal partner, also operates a placer mine on Eagle Creek in the Circle mining district of the eastern interior region and is diversifying its mining efforts into western Alaska. THURMAN OIL & MINING, another Interior-based operator, began mining pay on Sunset Creek in the Port Clarence district and will expand operations in 1989.

Operations in the Ruby and Tolstoi mining districts of the central Yukon River drainage continued at levels of previous years. SHORT GULCH MINING CO. LTD. (Keith Tryck) mined a rich pay streak on Ophir Creek in the Ruby-Poorman mining district with a crew of three. GREEN MINING AND EXPLORATION operated an open-pit placer mine on Long Creek, also in the Ruby district, and rerouted about 2,200 feet of the state access road 29 miles south of Ruby in preparation for the 1989-91 mining seasons. HOWARD MISCOVICH and HARTMAN INC. operated on Poorman Creek, the KANGAS-GREEN PARTNERSHIP mined on Ruby Creek, and PETE HAGGLAND sluiced on Bonanza Creek. CONRAD HOUSE continued his mining venture on Swift Creek in the Kaiyuh Hills. ROSANDER MINING COMPANY again operated the largest placer mine in the Tolstoi mining district west and north of McGrath. ALAMIN MINING operated a jig plant on nearby Bear Creek.

LOST RIVER MINING COMPANY (Len Grothe) produced 150 tons of contained tin from 200 tons of cassiterite concentrate at the Cape Creek mine near Tin City, in a remote area of western Seward Peninsula. LOST RIVER is the country's largest primary tin mine; the company ships cassiterite concentrate to Singapore, Malaysia, and Korea, for processing into tin 'shakes,' which are then marketed on a consignment basis to American and European buyers. Recent price hikes have enhanced the



Figure 31. Windfall Mining shows off reclaimed land at the company's placer operations near Nome. Photograph by C.B. Green, 1988.



Figure 32. Placer miners lift riffles from a sluice box at the Windfall Mining operation near Nome. Photograph by C.B. Green, 1988.

operation's profitability, but the mine faces closure if new reserves are not identified and developed in the near future.

### EASTERN INTERIOR REGION

Eighty-nine operations employed 415 persons and produced 76,550 oz of refined gold during 1988 in the eastern interior region--a 51 percent rise in production from the previous year--derived primarily from several large lode and placer mines.

Production in the Circle mining district, which includes the Birch Creek drainage, increased from 1986 and 1987. Twenty-four mechanized sluicing plants and 11 development projects were active in 1988, compared to 20 active mines and six development projects in 1987. The largest operations in the district were GHD RESOURCES on Eagle Creek, HELEN WARNER MINING on Porcupine Creek, GREENHORN MINING on Crooked Creek, and PAUL AND COMPANY on Deadwood Creek. Many placer miners in the Circle district reduced the size of their operations in 1988 to disturb less than 5 acres of land and therefore be exempt from the federal court injunction against operation of larger mines within certain drainages of interior Alaska.

Other operators district-wide include JIM WILDE and DISCOVERY MINING INC. on Switch Creek; ROY PHILPOTT on Smith Creek; JIM SWAN on Gold Creek, S&H ENTERPRISES on Revel Creek; JOHN COLE, the ZIEGLER-ROBERTSON PARTNERSHIP and POINTS NORTH (Bob Cacy) on Portage Creek; KISS COMPANY, MAGIC CIRCLE MINING (Steve Weber), VOGLER-DALE, FULTON, and GRADNEY on Deadwood Creek; FRED WILKERSON and JOHNSON MINING on Ketchum Creek; RED OLSON on Eagle Creek; DICK LOUD on Independence Creek; MCCALLUM on Gold Dust Creek; and the LESTER and BATTTEST opera-

tions on Birch Creek. The 24 active mechanized operations produced 17,900 oz of refined gold and are estimated to have contributed \$7.6 million to interior Alaska's economy.

Activity in the Livengood-Tolovana mining district remained about the same as 1987. ALASKA PLACER DEVELOPMENT, the largest operation in the area, hydraulically stripped and mined the Livengood Bench. ALASKA PLACER DEVELOPMENT employs a completely enclosed system which recycles 100 percent of mine process water. CARL HEFLINGER mined on Livengood Creek, and ED MONTGOMERY sluiced on Lillian Creek above the old Elliott Highway. The THORNTON and GERAGHTY operations continued gold production on Olive Creek. MAMMOTH MINES discontinued underground drift mining at Wilbur Creek in 1988.

Nine operations reported 1988 production in the historic Fortymile mining district, compared to eight in 1987. These numbers represent a 66-percent reduction from the 26 operating mines in 1985, a decrease which reflects the continued effects of court injunctions in the BLM lawsuit. Most operations in the region are small mechanized placer mines or floating suction dredges. CHARLES HAMMOND (45 PUP MINING) mined a small open cut on 45 Pup Creek south of Eagle, and HAM MINING COMPANY of Baraga, Michigan, operated a similar sluicing plant nearby. KACHEMAK BAY MINING CORPORATION (Mike Buzby) sluiced on Willow Creek in the Eagle Quadrangle, but reported that access and upgrading of water quality controls limited profitability. LARRY TAYLOR and DAVE LINKENS again mined on the Fortymile River with a crew of three. Other operators in the district included WILSON and KILE on Canyon Creek, WOLFF and THURNEAU on Walker Fork, and BIRDSSELL on Cherry Creek. Also, several suction dredges operated on the Fortymile River (fig. 33).

Miners who reported closure of Alaska mining operations due to federal management problems included KAVIC MINING, who relocated to Canada, after mining in Alaska for 35 years; FRANK HALL, whose operation on the Charley River had been halted by the NPS lawsuit; and GREAT LAND NORTH and ROBERT MCCLANAHAN, whose operations on the Fortymile River system were not approved by the court in the wake of the BLM lawsuit.

The Eureka-Tofty and Rampart mining districts experienced an extremely dry summer, which negatively affected mine operation. Three of five mines that operated last year were down, either for water recycling modification or reclamation requirements or from drought conditions. SALTER AND ASSOCIATES mined on Seattle Creek, and WILLFORD MINING took out a cut on 18 Pup on Hoosier Creek, in the Rampart mining district; STEVE LOSONSKY sluiced on Hunter Creek in the Rampart district; and MARK KRENZKE mined on Eureka Creek. Long-time miners JOHN SHILLING (Thanksgiving Creek), BILL CARLO (Hunter Creek), and JOHN DART (Boulder Creek) did not operate during the year. SHOREHAM RESOURCES, a subsidiary of GHD RESOURCES, plans a large scale open-cut placer mine on the Sullivan Bench near Tofty and expects to produce gold and byproduct tin in 1989.

The Fairbanks mining district, which includes the Upper Chatanika and Chena River Drainage, had another strong season and was the source of most of the increase in gold production in the eastern interior region. From 22 placer and 3 lode mines in the immediate Fairbanks area, 39,515 oz of gold and 11,972 oz of byproduct silver, together worth \$16.9 million were produced, and 214 jobs were created (127 at placer mines and 87 at lode mines). Of these, 88 were jobs of 8 months duration or more, while the remaining 126 were less than 8 months duration. SPHINX



Figure 33. A suction dredge works on the Fortymile River. Photograph by Bruce Campbell, 1988.

AMERICA INC. (SPHINX), near the junction of Fish and Fairbanks Creeks (fig. 34), and POLAR MINING (POLAR) on Sheep Creek were the largest placer operators in the eastern interior region and collectively processed 1,250,000 yd<sup>3</sup> of gravel through sophisticated sluicing plants; both companies operate on federally patented mining claims owned by the ALASKA GOLD COMPANY. POLAR and SPHINX conducted winter stripping, using backhoes, D-10 tractors with rippers, and blasting to strip frozen overburden. POLAR modified blasting schedules, reduced work hours, contained dust, and reduced noise levels with special mufflers on mine equipment in response to complaints from area residents.

Other mine operators in the district include CACY PATTON on Gilmore Creek; COOK'S MINING on Too Much Gold Creek; WALTER ROMAN on Pearl Creek; ALDER CREEK MINES on Alder Creek; AL HOPEN on Dome Creek; SMITH

BROTHERS MINING on Nugget Creek, tributary to Smallwood Creek; TAYLOR on Flume Creek; FRED CORNELIUS and JACK NEUBAUER on Fox Creek; RON ROMAN on Fish Creek; ANDY MISCOVICH on Twin Creek; DON

STEIN and WENTZ on Pedro Creek; EVECO on Goldstream Creek; and MCCLAIN and MCINTOSH on Faith Creek.

CITIGOLD ALASKA INC. recovered 9,850 oz of gold-silver bullion (5,700 oz gold, 4,150 oz silver) from two 100,000-ton leach pads at the Ryan Lode on Ester Dome (fig. 35). About 45 percent of the bullion was from the 1987 pad, and the remaining 55 percent was produced from the 100,000 tons of crushed and agglomerated ores stacked in 1988. CITIGOLD believes that crushing ores to 1/4 in. mesh sizes (from existing 3/4 in. mesh) will increase gold recovery. Additionally, new leach pad configurations should enhance recoveries during the short 6-month season. The company employed 25 miners and an additional 22 persons for contract excavation work during the 6-month 1988 season.

JOSH MOORE and EARL VOYTILLA mined the Adler gold-quartz vein and prepared a heap-leach pad. The two men crushed and agglomerated 7,000 tons grading 0.043 oz/ton gold for heap-leaching. The project was described by the principals as a technological success but an economic failure and will not be continued in 1989.

TRICON MINING, INC., a subsidiary of SILVERADO MINES (U.S.)



Figure 34. Sphinx America Inc. uses a backhoe to excavate deep Fairbanks Creek pay gravels within sight of the USSR&M's dredge No. 2, which was shut down in 1961. Photograph by C.B. Green, 1988.



Figure 35. Carbon column tanks recover gold from dilute cyanide solutions that percolate through ore heaps at the Ryan lode mine on Ester Dome near Fairbanks. Photograph by Thyse Shaub, 1988.

INC., operated the Grant mine and mill on Ester Dome continuously throughout 1988 (fig. 36). The mill was fed mainly with ores from the Elmes vein and the Ethel and Silver Dollar shear zone deposits on Ester Dome; TRICON also milled some 14,000 tons of ore for two other companies from the Cleary Hill and Tenderfoot Creek areas. Some 82,000 short tons of ore yielded 7,815 oz gold and 3,400 oz silver, for an average recoverable gold grade of 0.075 oz/ton gold. The company employed 35 persons including mill, engineering, assay, and contract mining personnel. The 1988 payroll contributed \$1,015,000 to the Fairbanks economy. Total expenditures for the operation (mining and milling costs) were \$2.5 million. The 270 ton/day mill used cyanide batch-leach and gravity concentration recovery circuits. In 1989, TRICON hopes to attract a joint venture partner, develop

the Gold Dollar vein deposits, construct a new tailings pond, and begin work to resume underground mining.

In the Tenderfoot area near Delta Junction, CHRIS GROPPLE conducted limited testing with underground methods on Tenderfoot Creek. BOB LOVELESS and JOHN RUBEL tested shallow placer deposits on Democrat Creek. TRI-VALLEY MINING COMPANY shipped approximately 73 tons of ore from mineralized rhyolite on Democrat Creek to the Grant mine and mill on Ester Dome for test-milling. JENSEN MINING continued work in the McCumber Creek area south of Delta Junction.

In the Bonfield mining district, on the north flank of the Alaska Range, seventeen placer operations sluiced gravels during 1988. The TOM FAA, CURLY ROWLAND, and TURNER operations worked placer

deposits on Moose Creek, historically the district's largest placer-gold producing location. The BASSETT-JOHNSON partnership employed an 8-cell jig plant for recovery of fine gold from pay streaks on their Gold King Creek properties. JACK LACROSS mined pay on California Creek, using an innovative screen plant, with Teflon-lined, oversize chutes, and a well-designed, long-term settling and recycling pond system. This system allowed him to reclaim tailings and at the same time maintain high water quality.

Other mines active in the Bonfield district included JAN CANNON on St. George Creek, LES ZERBA on Iron Creek, the BILLINGS and TRAXLER operation on Tatlanika Creek, SOUTHWOOD on Gold King Creek, and JAMES CUDE and the CLARKE BILLINGS operations on Totatlanika River.

#### SOUTHWESTERN REGION

In 1988, production declined and the number of operations decreased in the southwestern region, which includes the Aniak, Marshall, Iditarod, and most of the Innoko mining districts. In 1988, 33 mines employing 108 persons produced 14,800 oz of gold, compared to 36 mines, 129 employees, and 20,650 oz of gold in 1987, a production decline of 28 percent. This region saw the only significant decline in activities of any of Alaska's historic placer-mining regions.

TULUKSAK DREDGING COMPANY (TULUKSAK) outlined a pay streak to be mined at the upper end of Bear Creek, about 7 miles upstream from the mining camp of Nyac. However, the company was denied permits by BLM to mine the area. Although the upper Bear Creek pay streak had been worked with a dragline in the early 1950s, cumulative effects on the environment must be studied prior to project approval. During the 1988 shutdown, the company upgraded its hydroelectric power facility, which provides power to the

dredge, and increased power capabilities to about 750 kW from 450 kW. The company hopes to have the dredge back into production for the 1989 season. TULUKSAK continued work at its open-cut placer mine on nearby California Creek and signed an agreement with CALISTA CORPORATION to continue mining on their lands.

LYMAN RESOURCES OF ALASKA (LYMAN) continued mining a narrow but rich pay streak on Quartz Gulch, tributary to Donlin Creek, in the Aniak district. LYMAN also leases ground from CALISTA CORPORATION. In 1989, the company plans to finish mining the Quartz Gulch pay streak and to construct a new jig-trommel recovery system to replace their conventional sluicing plant. LYMAN recycles 100 percent of mine process waters. DAVE PENZ continued to develop a rich pay streak on Buster Creek, near the village of Russian Mission, on ground previously mined in the 1940s and early 1950s by oldtimer JOEL RAMSTAD. THE CHASE BROTHERS again mined placers on Stuyahok River east of Russian Mission, on ground leased from CALISTA CORPORATION. These remote placer mines employ local people and contribute to the economy of the lower Yukon and Kuskokwim River areas.

Further northeast, miners in the historic Iditarod district continued operating, in spite of water shortages and delays involved in designing new water treatment systems. MISCO-WALSH MINING COMPANY mined a residual placer deposit at the Golden Horn property, the FULLERTON BROTHERS mined on Flat Creek, ALVIN AGHOFF mined on Prince Creek, and RICHARD WILMARTH on Chicken Creek. JULIAN CREEK MINING COMPANY and partners resumed full-scale placer operations at Julian Creek in the George River drainage, after several years of reduced activity. Nearby, L.E. and MARILYN WYRICK mined near the head of Granite Creek. Late in the

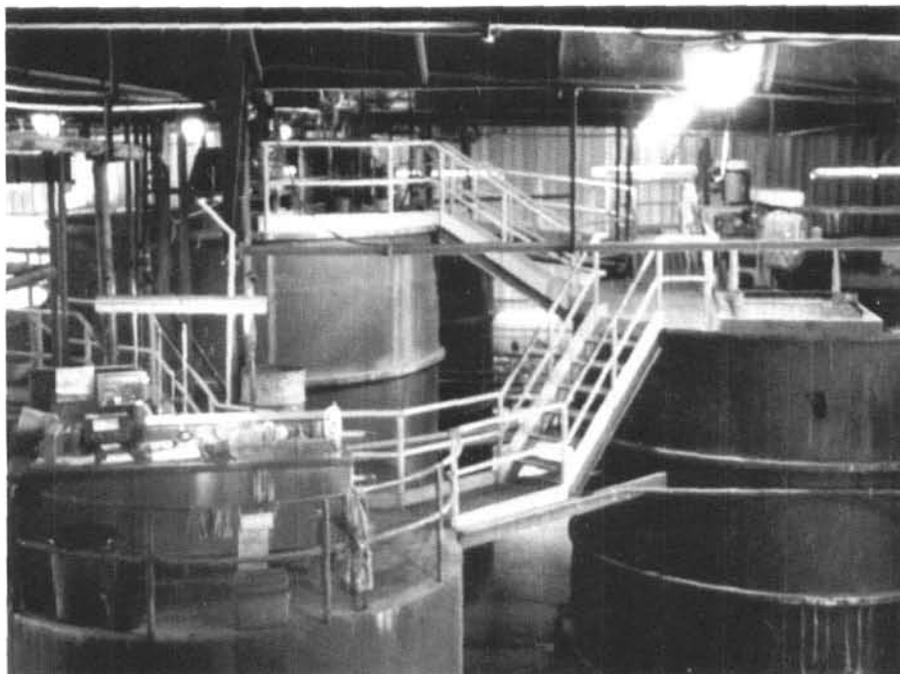


Figure 36. Vat leach tanks recover gold from milled ore at the Grant Mine on Ester Dome near Fairbanks. Photograph by Jim Deagen, 1988.

year, both companies signed exploration agreements with BATTLE MOUNTAIN MINING COMPANY, to investigate the lode potential of both areas. DON HARRIS did not sluice placer gravels on Moore Creek but concentrated instead on exploration and development.

Miners in the Innoko district operated at reduced levels from previous years. JOHN O'CARROLL worked Spruce Creek; JIM NORCROSS sluiced on Dodge Creek; PAUL SAYER mined pay on Little Creek during a season plagued with mechanical difficulties; and WARREN and LLOYD MAGNUSON developed bench gravels on Ganes Creek. Two operators on Yankee Creek--SMOKEY STOVER and the EEP-PUDDEN ANDERSON PARTNERSHIP--were down most of the summer and spent most of their efforts on 1989 mine plans.

#### SOUTHCENTRAL REGION

An estimated 30 mechanized mines employed 315 people and pro-

duced 68,300 oz of gold in the south-central region during 1988; 44,494 oz of refined gold (52,961 oz placer gold), or 66 percent of the region total, was from the VALDEZ CREEK MINING COMPANY (VCMC) placer mine 50 miles east of Cantwell. The VCMC operation is owned jointly by three Canadian firms: CAMINDEX MINES LTD. (now VALDEZ MINES LTD.), CAMBIOR MINES LTD., and AMERICAN BARRICK CORPORATION. Since operations began in 1984, VCMC has produced 140,018 oz of refined gold and led production in Alaska for 4 of the last 5 years. Early miners used open-cut and drift mining to exploit the Tammany channel, an incised and deeply buried ancestral paleochannel of Valdez Creek. VCMC has been exploiting two newly discovered paleochannels since the project's inception. This year 370,780 yd<sup>3</sup> of pay gravel, grading 0.12 oz/yd refined gold, were processed during the 12-month sluicing season. Approximately 6.5 million yd<sup>3</sup> of till, outwash, and lacustrine deposits were stripped from the 20-ft-thick pay streak

(fig. 37). Overburden ratios exceed 20:1. The overburden removal sequence included drilling and blasting 20-ft benches, and loading the material into 75-ton Komatsu haul trucks. Since the mine was opened in 1984, VCMC has refined ore reserve calculations and made other innovations to sustain year-round operation: (1) revised the pit design; (2) installed water seepage controls in pit walls; (3) winterized the recovery plant; and (4) installed boilers to heat process water for placer ore recovery (fig. 38). In January 1988, the operation was cited for improper waste oil and solid waste disposal and was assessed a fine of \$950,000 by the Alaska Department of Environmental Conservation. The company has installed a waste oil incinerator and has responded to other requirements of the action. The VCMC mine plan for 1989 calls for removal of 9.5 million  $\text{yd}^3$  of overburden and processing of 700,000  $\text{yd}^3$  of pay gravel. The company forecasts 1989 production at

84,000 oz of refined gold. In midsummer, VCMC geologists discovered fragments of an exceptionally old mammoth tusk in the paleochannel B pay zone. The paleontological find was sent to BLM archeologists in Anchorage for archiving and study (fig. 39).

In the Chistochina mining district, GOLD DUST MINES INC. used an IHC Jig recovery system to mine a low-grade pay zone on the Chisana Discovery claim on the south flank of the eastern Alaska Range. Unfortunately, the pay was found to be more limited in extent than previously thought, so equipment was demobilized late in the season. At nearby Ruby Gulch on Slate Creek, CHESNA GOLD COMPANY (CHESNA) leased placer property from ALASKA MINERAL RESOURCES COMPANY and mined thick outwash gravels for a short time late in the season. CHESNA spent much of the remaining time testing tailings and exploring unmined ground. This mine, when under operation by RANCHERS EXPLORATION from 1979-83, produced 19,666 oz of refined gold and was one of Alaska's largest producers of placer gold.

Twenty operators submitted placer mining applications for sites in the Cache Creek-Collinsville-Chunilna

River area of the Cache Creek mining district west of Talkeetna, but few actually mined. Close monitoring of anadromous salmon streams and conflicts with recreationalists were cited in questionnaire returns as reasons for mine inactivity. TC MINING worked ground on Thunder Creek in the Cache Creek drainage. Small scale recreational ventures and suction dredges were active on the Chunilna and Kahiltna Rivers and on Sourdough, Dollar, Falls, Nugget, Gold, Cache, Columbia, Bord, Peters, Rumble, and Bear Creeks, and Hanson Bar.

Small-scale placer-gold mining activity continued on the Kenai Peninsula. JOHN TRAUTNER operated a suction dredge on his Wagner claims near Sunrise. ALASKA STANDARD MINING INC. took initial steps to construct a custom ore processing facility in Seward, Alaska. The company has proposed a mill to process ores in crushing, grinding, batch leaching, and flotation circuits.

MRAK PLACER MINE stockpiled and processed gold-bearing glaciofluvial gravels near the juncture of Grubstake and Willow Creeks in the Hatcher Pass mining district north of Palmer. Gold has been found in gravel sections up to 70 ft deep in this area.



Figure 37. Placer geologist Dick Reger of DGGs stands in pay gravels hosting a glacial erratic boulder at the Valdez Creek Mine. Photograph by T.K. Bundtzen, 1988.



Figure 38. A covered conveyor feeds the winterized sluicing plant adjacent to the camp of the Valdez Creek Mine. Photograph by T.K. Bundtzen, 1988.

DEMPSEY MINING AND CONSTRUCTION mined placer gold from the Dempsey claim group on Mineral Creek near the coastal town of Valdez. The low grade placer deposit is hosted in glaciofluvial gravels similar to those of the Hatcher Pass and Kenai areas.

The federal court injunction against mining in Alaska's national parks has closed operations in

Wrangell-St. Elias National Park and Preserve since 1985. A small-scale, hard-rock silver-copper mine held by SILVER STAR MINING (the Barry Brothers) was maintained in standby status pending resolution of the lawsuit. IVAN THORALL, a long-time placer operator near Chisana, has also been prevented from mining his claims by the court injunction. Other operations that remained inoperative in-

clude TALMO MINING on Dan Creek, and HOFFMAN MINING near Kennecott.

ALASKA HARD ROCK MINING COMPANY mined 2,000 tons of gold-silver-telluride ore, averaging 0.85 oz/ton gold, from the Independence mine at Hatcher Pass. The company has announced that an additional 4,500 tons of similar grade reserves are proven in the mine stopes.

### SOUTHEASTERN REGION

Gold production in the southeastern region was once again concentrated in small operations in the Porcupine mining district near Haines. JOHN SCHNABEL operated BIG NUGGET MINE on Porcupine Creek and constructed a road to provide access for recreational miners. Panners and suction-dredgers took out small amounts of gold from McKinley and Nugget Creeks, also in the Porcupine mining district. ALASKAGOLD MINES (CUSAC LTD.) apparently did not operate its spiral washing plant at Cape Yakataga this year. CHARTER RESOURCES, INC. (CHARTER), ran a beach placer mining operation at Icy Bay, near Cape Yakataga (fig. 40). The company used an elevated sluice box fed by a 3/4-yd<sup>3</sup> backhoe. CHARTER is interested in leasing additional beach placer ground from NORTH COAST MINING of Juneau, which has been assessing placer potential in this area. Metal production from the southeastern region, including silver, gold, zinc, and lead, will rise significantly in 1989 with the startup of production from the Greens Creek mine near Juneau.

### INDUSTRIAL MINERALS

The value of industrial-mineral production during 1988 was \$73.4 million, an increase of 35 percent from the \$54.4 million recorded in 1987. The quantity of sand and gravel produced increased by a modest 3 percent, but volume and value of



Figure 39. Bob King (left) and Pete Oslund (right) examine a mammoth tusk fragment which was found in the pay gravels of Valdez Creek mine. Photograph courtesy of the U.S. Bureau of Land Management, 1988.

building stone more than doubled from the previous year (table 8).

Gravel production on the North Slope remained at low levels because the further development of the Kuparuk and Prudhoe Bay fields has not proceeded. Road, port, and mine construction at the Red Dog mine project accounted for most industrial minerals use in this region. In the eastern interior and southcentral regions, Alaska Department of Transportation and Public Facilities (DOTPF) construction activities decreased from 1986 and 1987 levels, as road projects in these regions have been completed; however, increased activity on road and harbor improvement in southeastern Alaska, associated with mine and timber development projects, bolstered production from 1987 levels to about 17 million tons. The 1988 average weighted value of sand and gravel statewide was \$2.81/ton, compared to \$2.56/ton in 1987 and \$3.75/ton in 1986 (table 11).

In the absence of new construction projects statewide, sand and gravel and building stone production may slacken in 1989, since construction at the Red Dog and Greens Creek mines, the Bradley Lake hydroelectric project, and several large DOTPF projects was essentially completed in 1988. One promising new prospect exists for export of Alaska sand-and-gravel products. Officials from the State of California visited Alaska in September 1988 to explore the possibility of exporting sand and gravel to their state through the Port of Seward.

#### NORTHERN REGION

Oil field development projects on the North Slope of Alaska, where nearly 25 percent of U.S. oil production occurs, have been major consumers of sand and gravel for a variety of road, pad, and infrastructure requirements. As much as 75 percent of statewide aggregate production historically occurred on the North Slope during peak years. Between 1974 and 1987, over 182 million tons of aggregate

were needed for the construction of haul roads, drill pads, airports, foundations, and other oil-field facilities needed for development of the North Slope. In the last three years, however, sand and gravel production for oil field development projects has accounted for less than 15 percent of the statewide total, the lowest recorded since oil was discovered at Prudhoe Bay in 1968. Most of the 722,341 tons of sand and gravel mined by ARCO and BP EXPLORATION (formerly STANDARD ALASKA PRODUCTION COMPANY) was for

causeway repair, island repair, and road maintenance. ARCO mines gravel for the Endicott project and for development at the Kuparuk field. In 1988, BP EXPLORATION's major project was construction of a new drill pad at Kuparuk; the company also completed repairs for the Endicott Causeway and the Endeavor and Duck Island projects. In mid-1988, the U.S. Army Corps of Engineers issued a report that discussed the impact of offshore causeway construction on marine wildlife and recommended that no future permits be granted for



Figure 40. A backhoe feeds processing equipment mining strandline gold deposits at Icy Bay. Photograph courtesy of Charter Resources.

Table 11. Reported sand and gravel production and industry employment in Alaska by region, 1988

Region	Volume (short tons)	Number of respondents	Stated <sup>a</sup> value (\$)	Number of employees
Northern	3,772,340	4	4.50/ton	375
Western	945,000	2	3.12/ton	14
Eastern/Interior	5,450,000	10	2.25/ton	185
Southwestern	22,500	2	12.00/ton	10
Southcentral	4,105,000	12	2.15/ton	115
Alaska Peninsula	70,800	2	8.50/ton	8
Southeastern	2,898,850	7	2.75/ton	45
TOTAL	17,264,490	39		752

<sup>a</sup>The stated value for each region is the weighted average of values taken from DGGS questionnaires or from telephone surveys of private and government sand and gravel users.

causeway construction in the Beaufort Sea. North Slope producers maintain the decision could severely limit offshore development of satellite fields adjacent to the Prudhoe Bay and Kuparuk fields.

Construction projects at the Red Dog mine and port sites accounted for the largest percentage of sand and gravel, aggregate, and building stone used in the northern region. During 1988, road and port construction required 617,000 tons of surface (coarse) aggregate and 103,000 tons of finer crushed aggregate. Additional embankment fill and riprap requirements called for 1,330,000 and 11,000 tons, respectively, for road and millsite construction; 750,000 tons of crushed rock and gravel were used to construct the starter tailings dam for impoundment of mill tailings.

#### WESTERN REGION

Industrial-minerals production in the western region was limited mainly to DOTPF road maintenance near Nome. JOHNSON ENTERPRISES (Galena, Alaska) mined 40,000 tons of gravel for local use near Nulato on the Yukon River.

#### EASTERN INTERIOR REGION

Ten sand and gravel operators in the eastern interior region reported production of 5.45 million tons, at a total value of \$12.26 million; 1987 production was 6.03 million tons. About 600,000 tons of riprap and quarry stone worth \$2.5 million were produced from three mines in the region. The relatively high demand for sand and gravel and building stone in this region has been sustained for several years by construction activities for the U.S. Army Light Infantry Division at Ft. Wainwright (Fairbanks), the federally funded DOTPF George Parks Highway project in south Fairbanks, and Alyeska pipeline maintenance and repairs along the Richardson Highway. However, with these projects essentially complete in 1988,

sand and gravel production in the eastern interior region will decrease significantly in 1989 unless new projects start.

FAIRBANKS SAND AND GRAVEL was again one of the region's top producers, mining 281,960 tons of gravel worth \$550,000 from an open-pit, floating-clamshell-dredge operation on the Tanana River flood plain. Other operators with significant production in 1988 were EVECO, ALASKA BASIC INDUSTRIES, H&H CONTRACTORS, EARTH MOVERS, and ROGERS AND BABLER, all of which produced from pits in the Tanana and Chena river flood plains.

An unusual gravel-extraction method in the Fairbanks area uses a Berger M-2 yarder, with its striking 120-ft mast located next to a water-filled pit just north of Parks Highway near Peger Road (fig. 41). The Berger yarder is normally used to collect (yard) logs from the woods during lumbering operations in the Pacific Northwest, but Wayne King of KING TRUCKING has adapted his yarder to mine sandy gravel in waters as deep as 100 ft, much deeper than the maximum 30-ft depth for other draglines.

King's yarder features a 10-yd<sup>3</sup> bucket suspended on a 1-in. steel cable and excavates and stockpiles up to 1,200 yd<sup>3</sup>/day.

POPO AGGIE INC. mined modest amounts of gravel from the Dry Creek pit near Healy for local road repair and building pad construction.

YUTAN CONSTRUCTION COMPANY (YUTAN) mined 315,000 tons of basalt rock, worth \$1.2 million, and minor amounts of gravel for construction activities in the Fairbanks area. This was a 25-percent decrease from production in previous years, due to decreased construction activity.

#### SOUTHCENTRAL REGION

Approximately 4.19 million tons of sand and gravel were mined in the southcentral region in 1988, compared to 4.29 million tons in 1987--a decrease of about 2 percent. Although construction has been slow, sand and gravel production in the Anchorage area over the past 3 years has maintained an annual rate of about 2.5 million tons, after record 6.5- to 7.0-million-ton levels of urban area usage in 1984 and 1985.

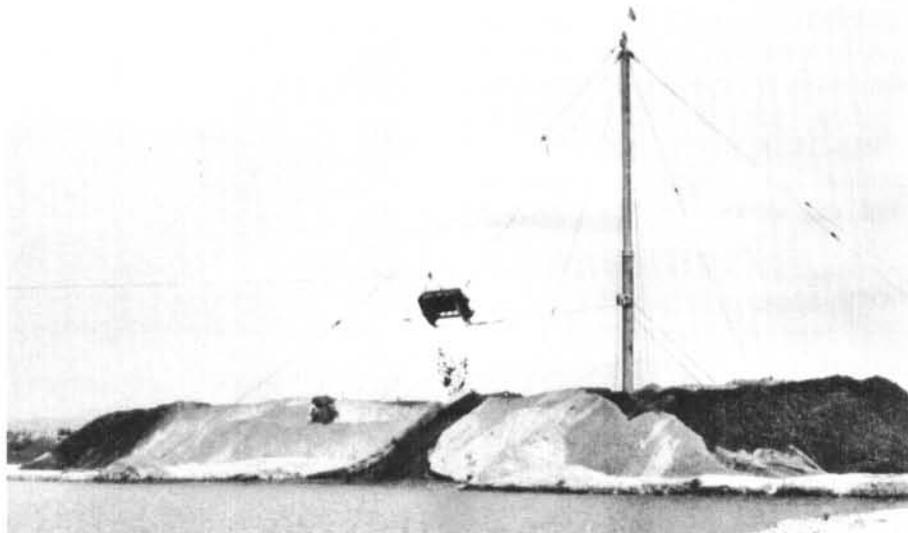


Figure 41. A Berger log yarder with a 120-ft mast was reconfigured by Wayne King of King Trucking to mine gravel to depths of 100 ft at a material site in Fairbanks. Photograph by Dick Reger, 1988.

In 1988, 1.74 million tons of sand and gravel were shipped from the Palmer-Wasilla area to Anchorage via the ALASKA RAILROAD (ARR). The railroad operated two 80-car unit trains during most of the construction season (table 12). Major projects in the Anchorage area which used sand and gravel and riprap included construction of the Federal Express 'Big Center,' rebuilding the Seward Highway from DeArmand Road to Potter's Marsh, the Ship Creek Development Project on ARR lands near the Port of Anchorage, and the Anchorage Municipal Dump. Most of the gravel for these projects was derived from the Highland Road pit in the municipality and from the Palmer-Wasilla area. The Seward Highway project was the largest gravel user in the region (2.7 million tons), and largely used material from local project sites.

ANCHORAGE SAND AND GRAVEL COMPANY operated its Schackleton pit in Palmer and shipped most of its 500,000 tons of production to Anchorage. Similarly, ALASKA AGGREGATE COMPANY (ALAGCO) produced 540,000 tons from its Palmer pit at mile 38, Glenn Highway and supplied ARR with shipments to Anchorage users. Another Palmer-area producer--AAA VALLEY GRAVEL--produced 49,827 tons of gravel which was marketed to both Mat-Su Valley and Eagle River construction projects. STAR CONSTRUCTION COMPANY mined small amounts of gravel and sand for local use in the Girdwood-Portage area.

ALASKA LIMESTONE COMPANY mined and processed about 4,800 tons of limestone from its Cantwell quarry (fig. 42) and supplied local markets with agricultural grade limestone and fertilizers. RED SMITH AND SON'S ENTERPRISES continued to develop an agricultural grade limestone from a travertine deposit in the Russian River drainage on the Kenai Peninsula. The mine plan incorporates open pit mining with a tracked loader. Near-surface travertine

reserves are estimated by the U.S. Forest Service at 48,136 tons. The project has been delayed by litigation (now in its fourth year) in seeking access and other mine rights on Forest Service lands.

#### ALASKA PENINSULA REGION

BRISTOL BAY NATIVE CORPORATION sold 65,000 tons of gravel through several leases within the corporation's region during 1988. KONIAG, INC., likewise sold or mined modest amounts of crushed rock and sand and gravel from its Womens Bay and Chiniak pits and produced shot rock from several Afognak Island quarries.

The CITY OF KODIAK hauled 800 tons of sand and 'pea gravel' from the Pillar Creek beach near town for street sanding operations in the 1988-89 winter.

#### SOUTHEASTERN REGION

Sand and gravel production in the southeastern region rose to 2.90 million tons, more than tripling 1987 pro-

duction. In addition, nearly 1.8 million tons of stone and aggregate--about 50 percent of stone production in Alaska--were quarried from the southeastern region. Most of the rise in production is attributed to construction at three mine sites in the Juneau mining district and road improvement in the Stikine subdistrict of Tongass National Forest. HILDRE SAND AND GRAVEL COMPANY (HILDRE) produced 187,000 tons of gravel, using draglines at their Acme pit north of Juneau. HILDRE shipped pit run material to the Greens Creek mine for final mill pad construction and washed sand for manufacture of concrete for foundations at the project. REDDEKOPP, INC. produced excellent volcanic-based shot rock at their Lena Point quarry north of Juneau and also shipped their product to the Greens Creek mine project. Contractors for CURATOR AMERICAN and ECHO BAY MINES LTD. constructed road and mine site facilities at the Kensington and Jualin projects near Berners Bay, north of Juneau, using 1.3 million tons of shot rock, aggregate, and gravel. CURATOR'S

Table 12. Major commodity tonnages hauled by the Alaska Railroad 1975-88 (thousands of short tons)<sup>a</sup>

Calendar year	Sand and gravel	Bulk petroleum	Coal	Other <sup>b</sup>	Total
1975	1	557	584	720	1,862
1976	104	624	607	853	2,188
1977	700	532	550	523	2,305
1978	727	374	593	484	2,178
1979	637	220	524	427	1,808
1980	396	252	590	503	1,741
1981	1,797	379	653	533	3,362
1982	2,754	439	654	656	4,503
1983	4,398	462	626	522	6,008
1984	6,537	498	642	595	8,272
1985	3,937	553	1,205	694	6,389
1986	2,200	750	1,343	712	5,005
1987	1,800	1,003	1,368	485	4,656
1988	1,740	1,000	1,400	400	4,620

<sup>a</sup>Figures for 1975-83 modified from Secretary of Transportation (1984); figures for 1984-85 by W.F. Coghill, Alaska Railroad; figures for 1986-88 by Bruce Carr, Alaska Railroad, and Charles Body, Usibelli Coal Mines, Inc.

<sup>b</sup>Piggyback, general manufactured goods, forest and agricultural products.

road to the Jualin property involved the use of 3 ft of shot rock fill some 35 ft wide for 1.4 miles of the 5-mile road from Berners Bay to the mine site. About 2 miles of mine road was completed at the Kensington project. ROCK AND ROAD CONSTRUCTION INC. quarried 5,000 tons of shale for construction needs near Petersburg; GUSTAVUS EARTH-MOVERS extracted 7,025 tons of sand and gravel 3/4 mile north of the Gustavus airport for both runway and road repair. The CITY OF KETCHIKAN extracted 6,525 tons of gravel from Granite Basin quarry for road maintenance and building pad construction in the Ketchikan Gateway Borough.

Region 10 of the Tongass National Forest reported extensive quarrying and gravel pit production, mainly for road construction. The Forest Service estimated that 1 million tons of rock and equal amounts of sand and gravel were produced by several contractors within the Stikine subdistrict--one of three subdivisions of Tongass National Forest.

## COAL AND PEAT

Alaska coal production in 1988 was 1.55 million tons, all of which came from the USIBELLI COAL



Figure 43. A young grizzly pauses on reclaimed land to observe activities at the adjacent haul road and mine pit at the Usibelli Coal Mine near Denali National Park. Photograph by C.B. Green, 1988.

MINE, INC. (UCM) (fig. 43). UCM shipped a record 810,862 tons of coal to the KOREAN ELECTRIC POWER COMPANY (KEPCO) through the SUN EEL SHIPPING COMPANY terminal at the Port of Seward in southcentral Alaska. UCM also shipped 13,467 tons to the ELECTRIC POWER DEVELOPMENT CORPORATION (EPDC) in Japan for a fluidized bed system test.

The EPDC facility (a 50-megawatt power plant) has tested coals from Australia, South Africa, Canada, New Zealand, and China. Testing results from the facility, which is expected to close down in 1989, will be used to design a full-scale power plant which will be customized for a preferred coal source. UCM's coal, although subbituminous in rank, performed well and showed superior handling qualities during the 2-year period of testing by EPDC. After recent price increases for South African and Australian bituminous coals, UCM coal has become more competitive with coal from the other sources. UCM also furnished 726,833 tons of coal to three military and four municipal power plants in interior Alaska, compared to the 707,200 tons used by these plants in 1987 (table 13).

During 1988, state royalty rates on UCM's producing Poker Flat coal leases were raised in accordance with the state regulations promulgated in 1982. Also, UCM and the Department of Natural Resources finalized the reclamation bond required by the state's surface mine permit for the Poker Flats pit and expect to complete



Figure 42. Alaska Limestone Company near Cantwell produces agricultural grade limestone for use by railbelt growers. Photograph by T.K. Bundtzen, 1988.

bonding for UCM's proposed Gold Run Pass mine pit by mid-1989.

Also in 1988, UCM evaluated the feasibility of building a power plant

and coal drying facility--(known as the Healy Cogeneration Plant (HCP)--at the mine-mouth in Healy. The HCP coal-fired power plant would use

fluidized-bed combustion technology to generate electricity while meeting the most stringent air quality emission standards. Waste heat from the plant would be used to dry excess moisture from crushed run-of-mine coal. The dried coal, which would be comparable to a premium, low-sulfur, bituminous coal, would be available for use in Alaska or for export. UCM is investigating the potential for receiving grant funds from the U.S. Department of Energy through the Clean Coal Technology demonstration program.

Horticultural peat production in 1988 was estimated at 55,000 yards; production remains at low levels statewide. As in 1987, nearly 65 percent of reported peat production occurred in the Fairbanks area, where GREAT NORTHWEST INC. and SVERDRUP CORPORATION operated peat pits on ground leased from the University of Alaska. Demand for peat in the Anchorage-Wasilla area continued to be weak, and former producers are awaiting a rebound in the construction industry.

Table 13. Market breakdown for 1988, Usibelli Coal Mine, Healy, Alaska<sup>a</sup>

Buyer	Coal (short tons)
<b>Domestic</b>	
Fort Wainwright (U.S. Army)	154,660
Clear and Eielson Air Force Bases	240,969
Golden Valley Electric Association	156,160
Fairbanks Municipal Utilities System	124,914
University of Alaska Fairbanks	42,320
Reliable Coal	7,810
Subtotal	726,833
<b>Export</b>	
Electric Power Development Corporation, Japan	13,467
Korean Electric Power Company	810,862
Subtotal	824,329
<b>TOTAL</b>	1,551,661

<sup>a</sup>Information provided by Usibelli Coal Mine, Fairbanks Municipal Utilities System, Golden Valley Electric Association, U.S. Army, and U.S. Air Force.

## DRILLING ACTIVITY IN 1988

### INTRODUCTION

Contract and in-house exploration and development drilling of placer, coal, and hard-rock deposits increased by 160 percent in 1988, rising to a total of 820,900 ft from 315,250 ft in 1987 (table 14). The most notable changes were threefold increases in the footage of hard-rock drilling and placer thaw-field drilling. The number of companies conducting major drilling programs increased from 20 in 1987 to 29 in 1988 (table 15). There were 33 major drilling exploration programs on hard-rock properties, three major drilling programs on placer properties, and two major drilling programs on coal properties.

### PLACER DRILLING

Placer drilling represented 55 percent of all drilling footage in Alaska and totaled 452,000 ft in 1988. Of this total, 53,450 ft was for exploration drilling of upland and offshore placer deposits, a 7-percent increase over placer exploration drilling in 1987. The VALDEZ CREEK MINING COMPANY drilled over 36,000 ft at the company's open pit placer property in southcentral Alaska, and GIANT BAY RESOURCES drilled over 7,000 ft on its offshore state mining leases in Norton Sound near Nome.

Of the remaining 398,550 ft of placer drilling, over 98,000 ft was drilled by WESTGOLD for the

development of its offshore mining leases near Nome, while 300,000 ft was drilled by the ALASKA GOLD COMPANY to install cold-water injection pipes for thawing frozen gravels ahead of the company's two upland bucketline dredges in Nome. The thaw-field footage exceeds the company's previous yearly high of 227,000 ft in 1986.

### COAL DRILLING

Coal exploration drilling in 1988 totaled 26,150 ft, an increase of 31 percent from 1987. The USIBELLI COAL MINE, INC., conducted exploration drilling in the upper Lignite Creek area on the company's state coal leases in the Nenana coalfield.

Table 14. Mineral-drilling footage in Alaska, 1982-88

	1982	1983	1984	1985	1986	1987	1988
Placer	124,000	53,000	129,000	80,000	259,400	180,250	452,000
Coal	80,000	12,000	25,700	8,700	28,800	19,900	26,150
Hard-rock	200,000	180,500	176,000	131,700	50,200	115,100	342,750
TOTAL	404,000	245,500	330,700	220,400	338,400	315,250	820,900

PLACER DOME U.S. INC. carried out a small drilling program on leases in the Beluga coalfield. MT. MCKINLEY MINING, which operates state leases in the Matanuska coalfield for IDEMITSU ALASKA INC., completed over 2,000 ft of core drilling and 19,000 ft of rotary drilling during the field season.

#### HARD-ROCK DRILLING

In 1988, drilling on hard-rock deposits totaled 342,750 ft, nearly tripling the 1987 total of 115,100 ft, and over six times the 7-year low of 50,200 ft in 1986. The increase reflects the success of grassroots exploration projects and prospect examination programs over the last one to three years. Over 98 percent of the hard-rock footage was drilled on precious-metal proper-

Table 15. Companies that conducted major drilling programs in Alaska, 1988

Alaska Gold Company	Golden Zone Resources
AMAX Exploration	Golden Sitka Resources
American Nickel & Copper	Greens Creek Mining Company
ASARCO	Hunt, Ware & Proffett
Ashton Mining	Idemitsu Alaska
Battle Mountain	Lac Minerals
BHP-Utah International	NERCO Minerals
BP Minerals America	Newmont Mining
Cominco Exploration Alaska	Placer Dome U.S. Inc.
Curator American	Shoreham Resources
Echo Bay Mines	Solomon Gold
Fairbanks Gold Ltd.	Tricon Mining, Inc.
FMC Gold	Usibelli Coal Mine, Inc.
Giant Bay Resources	Valdez Creek Mining Company
	Western Gold & Exploration

ties; only two companies reported drilling on primary base-metal properties. Also of interest, the total footage of rotary drilling equalled the footage of diamond drill core drilling

for hard-rock deposits in 1988. This reflects a very significant change from earlier years, when core drilling predominated.

## ALASKA'S 1988 METAL RECYCLING INDUSTRY

Ten companies in the Fairbanks, Anchorage, and Kenai areas recycled 4.38 million pounds of base-metal and composite alloy scrap and 28.02 million pounds of ferrous scrap metal for a total estimated worth of \$8.51 million, close to the 1987's total value of \$8.41 million (table 16).

Because many small companies did not submit volume and value figure for their products, and statewide survey efforts were not complete, the totals shown in table 16 are understated. At least 140 persons were employed in the metal recycling business. The four largest companies shipped nonferrous scrap metal and processed garbage, paper, plastics, and ferrous scrap metal for shipment to

dealers in Seattle and Pacific Rim markets.

Exports of all base-metal scrap increased 25 percent from 1987, and certain commodities such as aluminum showed even greater gains, but ferrous scrap metal exports decreased from 90 million lbs in 1987 to 28 million lbs in 1988, a decline of 68 percent.

K&K RECYCLING (K&K) of Fairbanks accounted for nearly 30 percent of total base-metal scrap exports statewide and was responsible for most of the Fairbanks area scrap metal business. K&K also exported its first baled shipments of base-metal scrap to Pacific Rim buyers; previously, K&K had shipped all its base-metal scrap by van to west coast and

midwestern buyers. K&K also shipped 5.15 million pounds of steel and cast iron scrap to Taiwan and Korea. ALUM RECYCLING, also of Fairbanks, reported a 110-percent increase in shipments of aluminum cans over 1987 volumes.

About 65 percent of total statewide export of base- and ferrous-metal scrap came from Anchorage, Wasilla, Willow, and Kenai recycling companies. Companies active in 1988 included RESOURCE RECYCLING (Willow); TUTTLE INC. and HUTTON ENTERPRISES (Kenai-Soldotna); and ANCHORAGE RECYCLING CENTER, ALASKA METALS RECYCLING, STAINO STEEL INC., M&M COMPANY,

Table 16. Scrap metal exports from Alaska 1987-88<sup>a</sup>

Commodity	1987		1988	
	Volume (lbs)	Value <sup>b</sup>	Volume (lbs)	Value
Copper/brass	1,789,680	\$2,147,616	1,512,930	\$2,345,041
Aluminum	1,165,960	1,748,940	2,394,607	2,993,259
Stainless steel	45,000	292,500	240,350	1,191,793
Car radiators	--	--	120,354	1,481,416
Zinc	--	--	21,684	16,263
Lead	474,800	189,920	94,500	37,800
Nickel-cobalt alloys (Inconel; Nimonic 'C')	25,000	200,000	4,800	48,000
Ferrous scrap (steel, pipe, cast iron)	90,000,000	3,825,000	28,023,000	1,401,000
<b>TOTAL</b>		<b>\$8,409,976</b>		<b>\$8,514,572</b>

<sup>a</sup>1987 information from Bundtzen and others (1988); 1988 information from 10 metal recycling companies, two in Fairbanks, five in Anchorage, one in Wasilla, and two in the Kenai-Soldotna area.

<sup>b</sup>Value estimates based on 1988 average metal commodity prices: copper (\$1.55/lb); aluminum (\$1.25/lb); stainless steel (\$5/lb); zinc (\$0.75/lb); radiator value (\$4/lb); lead (\$0.40/lb); nickel/cobalt alloys (\$10/lb).

-- = Not reported.

PRESCOTT EQUIPMENT, and STANDARD STEEL AND METALS (Anchorage). The ANCHORAGE RECYCLING CENTER (ARC) continued to operate its modern HRB high-density bailer, and processed most of the base-metal scrap collected in the Anchorage area (fig. 44). ARC reported that its copper and aluminum scrap shipments increased 61 percent and 124 percent, respectively, from 1987 levels. High metal commodity prices and strong demand have led to a sharp upturn in the base-metal scrap business. Tom Turner, ARC manager, estimated that seven 18-ton containers of base-metal scrap were shipped from the railbelt each month in 1988, excluding Fairbanks area operations. ARC, like K&K in Fairbanks, initiated direct scrap metal exports to Far East markets and expects to expand business in 1989. ARC is currently the only recycler in Alaska that sells recycled glass; 300 tons were shipped to West Coast processors in 1988. Ferrous scrap metal exports from ALASKA METALS RECYCLING, last year's biggest ferrous scrap metal exporter, decreased substantially due to

economic and technical problems with their Anchorage-based metal shredder which was installed in 1987. The shredder was restored to operation late in the year and is expected to

contribute substantially to ferrous scrap metal output in 1989. PRESCOTT EQUIPMENT continued to recycle surplus oil-industry steel such as drill pipe and bits, and oil derrick steel; recycled tonnages are expected to expand as increasing amounts of used equipment are returned from North Slope operations in 1989. Expensive alloy steels contained in this material are reprocessed at plants in the lower 48 and in Europe.

ALASKA BATTERY INC. (ABI) of Fairbanks, for 25 years a leader in recycling elemental lead from spent lead-antimony vehicle batteries, developed a special cold-weather acid-based car battery for potential marketing in Canada and Scandinavia. NORTHERN METALLIC INC. of Whitehorse, Y.T., will take over Canadian distribution of ABI products. ABI's Fairbanks operations were adversely affected after a 1988 environmental assessment, in which the EPA found soil at the company's south Fairbanks battery manufacturing plant to be contaminated with elemental lead and declared it a hazardous waste site. An expensive clean-up, involving



Figure 44. Baled scrap aluminum is stacked in front of the high-density baler operated by the Anchorage Recycling Center. Photograph by Tom Turner, courtesy of Anchorage Recycling Center, 1988.

removal of 2,000 tons of contaminated soil, took place during the summer.

ABI closed the Fairbanks operation and relocated its manufacturing

facilities at Big Lake, north of Anchorage, subsequent to the clean-up.

## MINING EDUCATION IN ALASKA

### INTRODUCTION

Alaska's integrated mining education programs begin in the elementary grades and continue through to graduate studies. With the resurgence of mining in Alaska, demand has increased for technically and professionally trained workers in the mining industry.

### DEPARTMENT OF EDUCATION PROGRAMS

#### ALASKA RESOURCES KIT: MINERALS

A program to develop a mineral and energy resource curriculum for use in primary and secondary schools was conceived in 1982 by John Blackwell, chairman of the Alaska Miners Association Education Committee, and the Alaska Department of Commerce and Economic Development. Funding for full-scale curriculum development was appropriated in 1983 by the legislature. The Alaska Department of Education directed and coordinated teacher development and disseminated materials. The instructional program, known as the 'Alaska Resources Kit: Minerals,' is designed to educate Alaska children about mining history, geology, the environment, and the role of mining in our economy (fig. 45). The kit is a K-through-12 classroom resource supplement. Teachers pick and choose from 31 different lessons and 150 student activities. The hands-on lessons are divided into four modules covering history, geology, technology, and ecology/economy. The modules are adaptable to various grade levels, learning styles, and subject areas. The kit contains a teacher's manual with lesson plans and student activities, posters, Alaska books and magazines,



*Figure 45. Elementary school children identify rock samples provided in the minerals and energy teaching kits jointly developed and funded by the Alaska Department of Education and donations from Alaska businesses and individuals. Photograph courtesy of the Alaska Department of Education.*

filmstrips, a video cassette, and a 40-specimen rock and mineral collection. Over 425 kits have been produced and distributed since fall 1985. The geology module of the teacher's manual was rewritten by Alaskan teachers during summer 1988 and will be distributed during 1989 for pilot testing.

Funds for production and distribution of kits and for training teachers are provided by the Department Education and by donations from businesses and individuals. The Alaska Mineral and Energy Resource Education Fund (AMEREF) is a nonprofit organization which raises private donations to support the program, and has representatives from industry, business, education, and government on its board of directors. The Department of Education has hired Thomas

Tunley, long-time Alaska geology teacher, to be on staff as a full-time minerals and energy specialist to continue program coordination.

### SECONDARY VOCATIONAL EDUCATION

The Alaska Department of Education (ADOE) developed a secondary vocational education mining curriculum during 1988. The curriculum is designed to prepare high school students for further technical training or entry level mining jobs. Richard Steele (Southeast Regional Resource Center) and Verdell Jackson (ADOE) authored the curriculum, with technical review provided by industry representatives.

### UNIVERSITY OF ALASKA PROGRAMS

The University of Alaska offers a broad range of mining classes statewide: at the Northwest College in Nome; at the Applied Mining Technology Program and School of Mineral Engineering, University of Alaska Fairbanks (UAF); at the Institute of Mining Technology (IMT) in Juneau; and through statewide support provided by the University of Alaska Anchorage Mining and Petroleum Training Service (MAPTS).

#### NORTHWEST COLLEGE

Northwest College, with support from Nome's mining industry and MAPTS, implemented a unique high school/college program to train entry level workers in mining. Classes are open to the community and are especially designed for high school students. Student retention rate has been high, and the college plans to make the course a permanent offering. The

nine-module curriculum was developed by Jeffrey Burton, UAF instructor of applied mining technology.

#### **APPLIED MINING TECHNOLOGY**

The Applied Mining Technology Program (AMT) at University of Alaska Fairbanks has awarded the largest number of credits among the statewide vocational mining programs. It is a one-year general program leading to an AMT certificate. Course offerings cover mineral exploration, environmental permitting, explosives, mine safety, surface and underground operations, fundamentals of coal mining, and special electives. During the 1988 field season, 29 AMT students were employed statewide in the mineral industry.

#### **INSTITUTE OF MINING TECHNOLOGY**

The Institute of Mining Technology (IMT) was established in 1987 at the University of Alaska Southeast in Juneau. This program alone provided 229 students with 55,000 hours of training in a 13-week period during 1988. The training program was a cooperative venture between IMT and MAPTS with assistance from several state and federal agencies. Graduates have accepted work at the Greens Creek mine, at hard-rock exploration projects in southeastern Alaska, and elsewhere in the state. To meet federal requirements, MSHA (Mine Safety and Health Administration) new miner training and annual refresher courses were also held during 1988 for mine employees, vendors, and contractors. Several informal workshops were held for area businesses to provide an overview of hard-rock mining and the goods and services needed in underground operations.

In addition to MSHA safety training for underground miners, training began at the Greens Creek mine for the first organized mine rescue team active in southeastern Alaska

since 1944. MSHA training specialist Jay Hart and Greens Creek Safety Supervisor Darren Case conducted mine rescue training for the Greens Creek rescue team at the IMT facility in Juneau, using MAPTS mine rescue equipment. In addition to new training equipment (blasting supplies and equipment, a sinking hammer, drill steels and bits, pumps, and hoses), a dedicated site for an underground training drift has been secured, and plans are underway to acquire a portable mill.

#### **MINING AND PETROLEUM TRAINING SERVICE (MAPTS)**

MAPTS trained more than 1,000 persons in mine related programs in 1988. Students were evenly divided between mandatory mine training--such as explosives, Mines Safety Health Administration (MSHA) and Office of Surface Mining (OSM) courses--and technical and skills training--such as milling, environmental affairs, drilling and underground mineral courses. Classes were conducted at 25 or more locations statewide.

Training equipment acquired by MAPTS during the year included several dozen cap lamps and charging racks, steel-toed boots, hard hats, safety belts, self-rescuers, a diamond drill, a four-wheel drive pickup, drill steels and bits, hand and power tools, AV equipment, protective clothing, over \$10,000 worth of instructional materials (fig. 46), and, for the Northwest College mining program, diesel mechanic tools.

In southcentral Alaska, year-round MSHA training for operators, miners, vendors, contractors, and governmental personnel was conducted in Anchorage, Seward, Palmer, and Homer. Specialized training in cyanide handling and safety, hazardous materials, and first aid was given in Anchorage and other locations.

In interior and western Alaska, Robert Greig from IMT (Juneau) and Jeff Burton with AMT (Fairbanks)

taught MSHA classes, made site visits, and assisted operators with mine training plans. The MSHA classes were funded by MAPTS, partly through the MSHA State Grants Program. To increase MSHA training throughout interior Alaska, MAPTS conducted a cooperative instructor training program for interior Alaska during June 1988 and certified eight additional cooperative instructors. MAPTS also continued the OSM Surface Coal Blasters Certification Program, with assistance from staff at Usibelli Coal Mine and the Alaska Division of Mining; 74 percent of the applicants became state-certified surface coal blasters. MAPTS staff revised the Alaska surface coal blasters manual and upgraded surface and underground training materials for the state Powder Handlers Fitness certificate.

#### **DEPARTMENT OF GEOLOGY AND GEOPHYSICS**

The Department of Geology and Geophysics at the University of Alaska Fairbanks offers undergraduate degrees in geology, and master's and doctoral degrees in geology and geophysics. The department offers a wide range of course work, with undergraduate degree options in general geology, economic geology, and petroleum geology. All undergraduates are required to take an intensive six-week field course to gain experience in geologic mapping and prospect examination.

The master's program in geology provides excellent opportunities for study of polymetallic skarn deposits, gold-bearing systems, placer, geology, and exploration geophysics. The geophysics master's program offers options in solid-earth geophysics and in snow, ice, and permafrost geophysics.

The University's Geophysical Institute is located at the Fairbanks campus and houses active research laboratories in the fields of seismology, volcanology, paleomagnetism, isotope geochronology, glaciology, and ice

physics. There are about 40 professional geoscientists in residence, and the Institute provides graduate and undergraduate research opportunities.

The Department of Geology and Geophysics places strong emphasis upon economic geology, and many graduates of the program are currently active with mining exploration companies in Alaska and throughout the world.

### SCHOOL OF MINERAL ENGINEERING

The School of Mineral Engineering at UAF contributes to Alaska's mineral industry in the areas of teaching, research, and public service (fig. 47). The school offers undergraduate degrees in mining engineering, geological engineering, and petroleum engineering, and graduate degrees in these programs and in mineral preparation engineering.

The mining engineering degree programs stress thorough grounding in theoretical and practical aspects of mining, with emphasis on underground and surface production of metallic ores and coal. Marine and on-shore placer mining, mining in permafrost, mining safety, and reclamation of mined-out areas are also studied.

Geological engineering students are instructed in unique arctic slope stability and hydrology factors, in addition to remote-sensing techniques, waste disposal, and exploration for mineral resources. Undergraduate studies in mining and geological engineering have been broadened to prepare students not only for the Alaska mining industry but for engineering positions in the mining industry worldwide.

Petroleum engineering at UAF offers a unique look at the challenging problems confronting the petroleum industry. Courses are offered in drilling, formation evaluation, production, reservoir engineering, computer simulation, and enhanced oil recovery.

The graduate program in mineral preparation engineering focuses on



Figure 46. A student uses testing equipment in the vocational mine training program of the Minerals and Petroleum Training Service (MAPTS). Photograph courtesy of MAPTS.



Figure 47. Professor Frank Skudryck teaches a class in the rock mechanics laboratory at the School of Mineral Engineering, University of Alaska Fairbanks. Photograph courtesy of the University of Alaska Fairbanks.

hydrometallurgical processing of complex sulfide ores from interior Alaska, on research in drying of Alaska's moisture-rich coals, and on techniques for improving water treatment.

In addition to state-of-the-art equipment and laboratories on campus, the School of Mineral Engineering owns the Silver Fox Mine and has access to the permafrost tunnel—both

nearby in Fox, Alaska. These field sites give students the opportunity for hands-on experience in mining and geological engineering. Research grants from the U.S. Bureau of Mines and a variety of industrial research grants and contracts provide support for 20 or more graduate students, who conduct studies of importance to the Alaska mineral industry.

As a public service to members of the mining industry and to government, the School faculty is available to consult on mineral engineering matters. An estimated 100 miners sought and received advice and/or had laboratory testing of ores or concentrates done through the School's Mineral Industry Research Laboratory during 1988.

#### MINING EXTENSION PROGRAM

The University of Alaska has offered statewide mining extension courses since 1935. The current Mining Extension Program offers a variety of courses in mineral prospecting, and introductory courses in mapping, mining, milling, mine safety, ore deposits, mineral evaluation and environmental factors. The Extension program offers a one-year 'Professional Prospectors' certificate and a two-year 'Mineral Exploration and Mining Technology' certificate. The program has an open admissions policy, and since 1985 over 1,000 students have completed extension service courses and 19 students have completed the requirements for the one and two-year certificate programs.

In addition to courses given for credit, the Extension program offers gold prospecting, basic prospecting and rock and mineral identification courses that can be taught in various Alaska communities upon request. The Mining Extension instructor is also available to make on-site mine visits to assist miners with technical questions, and works with the School of Mineral Engineering, Mineral Industry Research Laboratory, in

solving technical problems confronting the small miner.

For more information on any of the education programs described in this section, the following people should be contacted.

John Blackwell  
Alaska Minerals and Energy  
Resource Education Fund  
(AMEREF)  
c/o Engelhard West Inc.  
301 W. Northern Lights Blvd.  
Suite 101  
Anchorage, AK 99503  
(907) 274-2211

Jeffrey Burton  
Applied Mining Technology Program  
SCCE-UAF  
Hutchison Career Center  
Geist Road  
Fairbanks, AK 99709  
(907) 474-5081

Dr. Donald Cook  
Dean, School of Mineral Engineering  
208 Brooks Building  
University of Alaska Fairbanks  
Fairbanks, AK 99775  
(907) 474-7366

Amelia Dickerson  
Instructional Coordinator  
Northwest College  
Pouch 400  
Nome, AK 99762  
(907) 443-2201

Robert Greig, Lead Instructor  
Institute of Mining Technology  
University of Alaska Southeast  
P.O. Box 22434  
Juneau, AK 99802  
(907) 463-4840

Verdell Jackson  
Vocational Education Program  
Manager  
Department of Education  
P.O. Box F  
Juneau, AK 99811  
(907) 465-2841

James A. Madonna  
Mining Extension Program  
204 Brooks Building  
University of Alaska Fairbanks  
Fairbanks, AK 99775  
(907) 474-7702

Dennis Steffy  
Mining and Petroleum Training  
Service  
155 Smithway  
Soldotna, AK 99669  
(907) 262-2788

Dr. Samuel Swanson, Chairman  
Department of Geology and  
Geophysics  
University of Alaska Fairbanks  
Fairbanks, AK 99775  
(907) 474-7565

Thomas Tunley  
Minerals Coordinator  
Department of Education  
P.O. Box F  
Juneau, AK 99811-0500  
(907) 465-2841

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**APPENDIX A**  
**Total active claims and new claims staked in 1986, 1987, and 1988<sup>a</sup>**  
**(listed by quadrangle)<sup>b</sup>**

Quadrangle	Active claims assessment work			New claims staked						Total active claims		
	1986	1987	1988	Federal			State			1986	1987	1988
				1986	1987	1988	1986	1987	1988			
13 Umiat	1	0	0	0	0	0	0	0	0	1	0	0
14 Sagavanirktok	0	0	0	1	1	1	0	0	0	1	1	1
15 Mt. Michelson	0	0	0	0	0	0	0	0	0	0	0	0
17 Point Hope	547	0	0	0	0	0	0	0	0	547	0	0
18 De Long Mts.	4,617	2,104	1,809	0	0	0	0	0	0	4,617	2,104	1,809
23 Phillip Smith Mts.	36	13	13	19	12	5	10	3	0	65	28	18
26 Noatak	905	532	184	0	0	0	15	0	0	920	532	184
27 Baird Mts.	89	225	299	2	0	0	0	0	0	91	225	299
28 Ambler River	839	294	110	0	0	0	0	0	0	839	294	110
29 Survey Pass	346	94	34	0	0	0	0	0	0	346	94	34
30 Wiseman	1,755	1,468	1,767	30	17	6	30	66	143	1,815	1,551	1,916
31 Chandalar	909	899	945	22	3	12	12	62	28	943	964	985
32 Christian	1	1	1	0	0	0	0	0	0	1	0	1
35 Kotzebue	0	0	16	0	0	16	0	0	0	0	0	16
36 Selawik	0	0	0	0	0	0	0	0	0	0	0	0
37 Shungnak	71	59	51	0	0	0	0	0	0	71	59	51
38 Hughes	54	54	54	0	0	0	0	0	0	54	54	54
39 Bettles	597	508	422	7	17	30	4	27	1	608	552	453
43 Teller	1,388	1,312	383	0	0	0	15	0	145	1,403	1,312	528
44 Bendeleben	1,363	1,302	1,138	4	5	9	24	48	158	1,391	1,353	1,305
45 Candle	557	449	463	0	14	8	78	24	9	635	487	480
47 Mclozitna	32	76	134	0	32	6	27	19	0	59	127	140
48 Tanana	1,518	1,461	1,596	0	0	1	71	175	19	1,589	1,636	1,616
49 Livengood	3,719	3,596	3,290	0	0	0	189	301	428	3,908	3,897	3,718
50 Circle	3,268	3,600	3,944	2	2	0	351	606	1,397	3,621	4,208	5,341
51 Charley River	263	193	183	0	0	0	4	0	0	267	193	183
52 Nome	358	518	293	0	0	5	59	17	344	417	535	637
53 Solomon	829	200	881	1	0	24	39	64	40	869	264	945
54 Norton Bay	110	0	110	0	0	0	0	0	0	110	0	110
55 Nulato	3,173	3,500	3,178	16	14	10	144	0	0	3,333	3,514	3,188
56 Ruby	1,152	1,107	974	0	0	0	9	4	304	1,161	1,111	1,278
57 Kantishna River	299	287	275	0	1	0	0	0	0	299	288	275
58 Fairbanks	2,127	2,699	2,505	75	0	0	195	346	419	2,397	3,045	2,924
59 Big Delta	1,056	1,146	1,841	55	31	0	60	408	786	1,171	1,585	2,627
60 Eagle	2,069	2,357	2,256	0	0	118	163	60	558	2,232	2,417	2,932
63 Unalakleet	0	0	0	0	0	0	0	0	0	0	0	0
64 Ophir	384	500	474	0	9	0	8	13	192	392	522	666
65 Medfra	502	539	293	0	1	0	56	48	0	558	588	293
66 Mt. McKinley	287	174	319	0	0	0	0	0	0	287	174	319
67 Healy	3,790	3,249	3,289	704	256	736	150	185	172	4,644	3,690	4,197
68 Mt. Hayes	3,515	4,196	4,682	56	249	56	337	95	247	3,908	4,486	4,985
69 Tanacross	751	486	1,150	0	18	0	168	193	165	919	697	1,315
72 Holy Cross	14	14	9	0	0	0	0	0	0	14	14	9
73 Iditarod	565	514	620	13	1	646	4	152	437	582	667	1,703
74 McGrath	109	167	325	0	0	0	0	0	238	109	167	563
75 Talkeetna	1,935	2,179	1,884	0	0	5	209	51	181	2,144	2,230	2,070
76 Talkeetna Mts.	1,292	1,600	1,907	0	0	16	129	127	122	1,421	1,727	2,045
77 Gulkana	16	19	19	0	0	0	0	13	21	16	32	40
78 Nabesna	440	280	246	8	0	0	7	0	0	445	280	246

<sup>a</sup>Total count based on all documents recorded through January 1, 1989.

<sup>b</sup>Quadrangles numbered northwest to southeast according to DGGs-DOM numbering and Kardex systems.

Quadrangle	Active claims assessment work			New claims staked						Total active claims		
	1986	1987	1988	Federal			State			1986	1987	1988
				1986	1987	1988	1986	1987	1988			
81 Russian Mission	50	2	58	1	0	5	0	0	0	51	2	63
82 Sleetmute	295	332	231	0	0	40	28	33	45	323	365	316
83 Lime Hills	368	135	28	0	0	0	4	16	0	372	151	28
84 Tyonek	6,575	5,177	4,632	0	0	0	492	53	63	7,067	5,230	4,695
85 Anchorage	1,052	1,135	906	0	3	9	231	115	71	1,283	1,253	986
86 Valdez	283	299	305	9	8	102	24	293	8	316	600	321
87 McCarthy	170	66	205	0	0	0	0	0	0	170	66	205
91 Bethel	600	66	454	0	0	24	0	4	37	600	70	515
92 Taylor Mts.	283	386	204	0	0	0	0	9	168	283	395	372
93 Lake Clark	411	318	395	0	0	0	0	0	150	411	318	495
94 Kenai	2	5	12	0	0	0	6	5	5	8	10	17
95 Seward	1,444	1,261	2,340	164	557	379	58	95	30	1,666	1,913	2,749
96 Cordova	23	15	15	2	0	0	0	0	0	25	15	15
97 Bering Glacier	231	604	310	0	0	0	22	300	0	253	904	310
101 Goodnews	26	6	2	0	0	0	0	0	39	26	6	41
102 Dillingham	18	18	7	0	0	0	0	0	0	18	18	7
103 Iliamna	23	86	572	0	0	0	0	0	720	23	86	1,292
104 Seldovia	13	87	13	0	0	0	0	0	0	13	87	13
105 Blying Sound	2	2	1	0	0	0	0	0	0	2	2	1
107 Icy Bay	6	11	6	0	0	14	18	0	0	24	11	20
108 Yakutat	2	1	1	0	0	0	0	0	0	2	1	1
109 Skagway	468	209	511	15	5	0	7	4	0	490	218	511
111 Mt. Fairweather	4	6	2	2	0	18	0	1	0	6	7	20
112 Juneau	1,184	2,173	3,428	211	1,213	890	68	38	62	1,463	3,424	4,380
113 Taku River	0	0	0	0	0	0	0	0	0	0	0	0
114 Sitka	717	785	644	0	20	9	1	0	11	718	805	664
115 Sumdum	140	45	147	0	54	14	0	0	0	140	99	161
116 Port Alexander	184	0	184	0	0	0	0	0	0	184	0	184
117 Petersburg	1,164	1,497	789	50	129	109	2	0	5	1,216	1,616	903
118 Bradfield Canal	8	8	122	4	240	35	0	0	0	12	248	157
119 Craig	702	502	780	112	182	337	38	0	57	852	684	1,174
120 Ketchikan	430	261	367	152	148	34	0	0	0	582	409	401
121 Dixon Entrance	517	333	184	2	22	74	0	0	0	519	355	258
122 Prince Rupert	8	8	9	0	1	0	0	0	0	8	9	9
123 Hagemeister Island	338	0	505	0	0	0	0	0	36	338	0	541
126 Mt. Katmai	0	0	0	0	0	0	0	0	0	0	0	0
127 Afognak	2	3	2	0	0	0	0	0	0	2	3	2
130 Karluk	0	0	0	0	0	0	0	0	0	0	0	0
133 Chignik	110	51	71	0	0	0	0	0	0	110	51	71
135 Trinity Islands	161	158	895	0	0	0	12	982	1	173	1,140	896
138 Port Moller	44	51	38	0	0	0	1	0	0	45	51	38
TOTAL	65,705	60,072	63,694	1,739	3,274	3,786	3,579	5,002	8,062	71,014	68,348	75,542

## APPENDIX B

### State, federal, and private agencies involved in mineral development activities, 1988

#### 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  
Acting Director - Tom Lawson  
Development Specialists -  
Gerry Engel, Jim Deagen

1001 Noble St., Ste. 360  
Fairbanks, AK 99701  
(907) 452-7464  
Development Specialist - Charles B. Green

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  
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.

Also advises land-management agencies by preparing compilations of fish, wildlife and habitat, and public-use information; assessing habitat requirements and potential impacts; setting guidelines and recommendations for preventing, reducing, or mitigating fish, wildlife, habitat, and human harvest losses.

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  
P.O. Box AW (mailing)  
431 North Franklin St.  
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.  
State II (mailing)  
Fairbanks, AK 99701-4596  
(907) 451-2818  
Project Coordinator - Elizabeth Benson,  
Patti Wightman

Southcentral Regional Office  
2600 Denali St., Ste. 700  
Anchorage, AK 99503-2798  
(907) 274-1581  
Project Coordinator - Patty Bielawski

Southeastern Regional Office  
P.O. Box AW (mailing)  
431 North Franklin St.  
Juneau, AK 99811-0165  
(907) 465-3562  
Project Coordinators - Diane Mayer,  
Barb Sheinberg

##### 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

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., Frontier Bldg., 10th Fl.  
P.O. Box 7005 (mailing)  
Anchorage, AK 99510  
(907) 762-2117  
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  
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

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., Frontier Bldg.  
P.O. Box 7005 (mailing)  
Anchorage, AK 99510  
(907) 762-4355  
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 - Jerry Brossia

**Southcentral Regional Office**

3601 C St., Frontier Bldg., Ste. 1080  
P.O. Box 7005 (mailing)  
Anchorage, AK 99510  
(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  
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  
Permit Manager - Judd Peterson  
Mining Information Office -  
Carole H. Stevenson

**Juneau Office**

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

**Division of Parks and Outdoor Recreation**

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**

P.O. Box 107001 (mailing)  
Anchorage, AK 99510-7001  
(907) 762-2616  
Regional Manager - Al Meiners

**History and Archaeology Section**

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 - Linda Kruger

**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**

P.O. Box SA (mailing)  
Juneau, AK 99811-0400  
(907) 465-2343

Director - Steven E. Kettel  
Audit Office Supervisor - John Hansen

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 geo-

physics 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  
Dean - Donald J. Cook

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)**

210 O'Neill Resources Bldg.  
(907) 474-7135 or 7136  
Director - Donald J. Cook  
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**

204 Brooks building  
(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  
701 C St.  
P.O. Box 13 (mailing)  
Anchorage, AK 99513  
State Director - Michael Penfold  
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

District Manager - Thomas Dean

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

District Manager - Roger Bolstad

Steese-White Mountain Office  
1150 University Ave.  
Fairbanks, AK 99709-3844  
(907) 474-2350

District Manager - Don Runberg

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

District Manager - Mary Leykom

Tok Field Office  
P.O. Box 307 (mailing)  
Tok, AK 99780  
(907) 883-5121  
Manager - Bob Buritt

#### 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. Hockzema

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 020550 (mailing)  
Juneau, AK 99802-0550  
(907) 364-2111  
Assistant Chief - David Carnes

Fairbanks Field Office  
206 O'Neill Resource Bldg.  
905 Koyukuk Ave. North  
University of Alaska  
Fairbanks, AK 99775-5140  
(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 Services/Endangered Species Branch

101 12th Ave.  
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) 271-4138

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) 561-5555

#### National Park Service

Alaska Regional Office  
2525 Gambell St.

Anchorage, AK 99503  
(907) 257-2690

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  
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. Co-

operates 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. Demischici

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  
Regional Administrator - Robie Russell

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  
701 C St.  
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) 753-2724 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 AGENCY

Alaska Land Use Council  
1689 C St., Ste. 100  
Anchorage, AK 99501  
(907) 272-3422  
Federal Coordinator - Ron McCoy  
State Cochairman 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 - Deanne Adams  
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.

#### BOARD 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, and January 1989.

#### Citizens' Advisory Commission on Federal Areas

515 7th Ave., Ste. 310  
Fairbanks, AK 99701  
(907) 456-2012  
Chairman - 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  
 Chairwoman - Peg Tileston  
 (907) 561-0540  
 Water Resource Board Coordinator -  
 Mary Lou Harle  
 (907) 762-2680

Function: The Alaska Water Resources Board was created by Art. 3 of AS 46.15, the Water Use Act of 1966. This seven-member citizen 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 Commission of Environmental Conservation is an ex-officio member, and the Commissioner of Natural Resources is the executive secretary and provides staff assistance for the board. Members are appointed by the Governor, subject to confirmation by the Legislature. Board members represent a geographic diversity and a variety of occupations and professions associated with water resources. 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**

State Chamber of Commerce  
 State Natural Resources and Energy  
 Committee  
 957 West Bury Dr.  
 Anchorage, AK 99503  
 (907) 561-2332  
 Co-Chairman - Douglas Stark

Function: Standing committee for 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 Director.

Greater Fairbanks Chamber of Commerce  
 Mineral Development Committee  
 P.O. Box 74446  
 Fairbanks, AK 99707  
 (907) 452-1105  
 Co-Chairmen - Jeff Burton, 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  
 415 F St.  
 Anchorage, AK 99501

Natural Resource Committee  
 Chairperson - 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  
 Rich Hughes, Statewide President  
 Curt Mevee, Executive Director

Anchorage Branch  
 Norm Lutz, Chairman  
 501 West Northern Lights Blvd.,  
 Ste. 203  
 Anchorage, AK 99503  
 (907) 274-6473

Fairbanks Branch  
 Susan Knapman, Chairman  
 P.O. Box 73069  
 Fairbanks, AK 99707  
 (907) 451-6650

Juneau Branch  
 Neil MacKinnon, Chairman  
 P.O. Box 21684  
 Juneau, AK 99802  
 (907) 364-3144

Kenai Branch  
 Dennis Steffy, Chairman  
 c/o Mining & Petroleum Training  
 Service (MAPTS)  
 155 Smith Way, Ste. 104  
 Soldotna, AK 99669  
 (907) 262-2788

Nome Branch  
 Joe Fisher, President  
 P.O. Box 242  
 Nome, AK 99762  
 (907) 443-5272

**Alaska Women in Mining**  
 Caroline Roland, President  
 P.O. Box 83743  
 Fairbanks, AK 99708  
 (907) 452-1022

**Society of Mining Engineers**  
 Caller No. D  
 Littleton, CO 80162-5002  
 (303) 973-9550

Alaska Section  
 Milton A. Wiltse, Chairman  
 794 University Ave., Ste. 200  
 Fairbanks, AK 99709  
 (907) 474-7147

Southern Alaska Branch  
 Charles Drummond, Chairman  
 2525 Gambell St., Rm. 107  
 Anchorage, AK 99503  
 (907) 271-4213

**American Institute of Professional Geologists**  
 7828 Vance Dr., Ste. 103  
 Arvada, CO 80003  
 (303) 431-0831

Ross Schaff, President  
 Alaska Section  
 Pouch 6900  
 Anchorage, AK 99502  
 (907) 338-4200

**Miners Advocacy Council**  
 Josh Moore, President  
 P.O. Box 73824  
 Fairbanks, AK 99707  
 (907) 452-6227

**Northwest Mining Association**  
 William C. Booth, President  
 414 Peyton Bldg.  
 Spokane, WA 99201  
 (509) 624-1158

**Placer Miners of Alaska**  
 John Korobko, President  
 P.O. Box 73756  
 Fairbanks, AK 99707  
 (907) 479-0471

**Resource Development Council for Alaska,  
Inc.**

Shelby Stastny, 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 99707

Circle Mining and Recording District  
Susan Knapman, President  
P.O. Box 1872  
Fairbanks, AK 99730 (summer address)  
1215 Choctaw  
Fairbanks, AK 99705 (winter address)

Fairbanks Mining District  
Don Stein, President  
105 Dunbar  
Fairbanks, AK 99701

Forty-Mile Miners Association  
Mike Busby, President  
General Delivery  
Chicken, AK 99732

Juneau Mining District  
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 73069  
Fairbanks, AK 99707

Seward Mining District  
Tom Williams, President  
Box 66  
Hope, AK 99605

Valdez Mining District  
Claud Morris, President  
P.O. Box 547  
Girdwood, AK 99581

Yentna Mining District  
John Jacobsen, President  
700 Ash Pl.  
Anchorage, AK 99501

**APPENDIX C**  
**Selected significant mineral deposits in Alaska**  
**(locations shown in figs. 48 through 50)<sup>a</sup>**

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. According to COMINCO (February 1982), 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** - Strata-bound (Pb-Zn-Ag) massive sulfide occurrence associated with black shale, chert, and felsic volcanic rocks; 60-ft by 120-ft exposure averages 17.4 percent Zn, 3.0 percent Pb, and 3.3 oz/ton Ag; numerous sulfide occurrences and strong geochemical anomalies between localities 1 through 4 and locality 7.
- 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.
- 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, 44 percent Zn, 0.14 oz/ton Au, and 14.8 oz/ton Ag.
- 7 **Omar, Frost** - 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.
- 8 **Bornite** - Major stratiform Cu-Zn deposit in 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.
- 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.
- 11 **Snuckee** - Middle Paleozoic volcanogenic massive sulfide deposit; 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 2.5 percent Cr.
- 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.
- 18 **Porcupine Lake** - Stratiform fluorite occurrences associated with felsic volcanic rocks of late Paleozoic age. Reported grades of up to 25 to 30 percent fluorite reported.
- 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. Grab samples contain up to 1 percent Cu, 0.16 percent Zn, and 0.002 percent Mo.
- 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.
- 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

<sup>a</sup>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.

- 24.6 million tons that grade 0.15 percent Sn, 16.3 percent  $\text{CaF}_2$ , and 0.03 percent  $\text{WO}_3$ , 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.
  - 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 **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  $\text{WO}_3$ .
  - 32 **Solomon mining district** - Major placer Au district; produced over 250,000 oz Au.
  - 33 **Kachauik** - Uranium prospect in Cretaceous alkalic intrusive rocks. Highly anomalous geochemical values and U concentrations of 1,000 ppm reported.
  - 34 **Omaliik** - 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.
  - 35 **Windy Creek** - Disseminated Mo-Pb-Zn mineralization in quartz veins and skarns with reported values as high as 0.15 percent Mo.
  - 36 **Quartz Creek** - Significant Pb-Zn-Ag mineralization; reported grades of 15 percent combined Pb-Zn and 10 oz/ton Ag.
  - 37 **Placer River** - Significant Mo-F mineralization disseminated in intrusive rocks. Reported values of 0.2 percent Mo.
  - 38 **Candle Creek** - Placer Au deposits with significant reserves. Placer concentrates reported to have significant U and galena concentrations.
  - 39 **Poovookpuk Mountain** - Porphyry Mo mineralization. Reported grades of up to 0.25 percent Mo.
  - 40 **Purcell Mountain** - Mo and Ag occurrences associated with Cretaceous alkalic igneous plutons, alaskite, and bostonite dikes.
  - 41 **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.
  - 42 **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.
  - 43 **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.
  - 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 tectite and skarn near Cretaceous quartz monzonite.
  - 50 **Mt. Prindle** - Significant uranium-rare-earth mineralization in Mesozoic alkaline igneous rocks. Rock geochemical values of up to 0.1 percent  $\text{U}_{308}$ ; 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** - Stratabound 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 Bonfield

- 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 m.y. 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. Proven reserves of about 10 million tons of 0.1 oz/ton Au with Cu and Ag reported.
- 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 m.y. 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.
- 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 Chitstone 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.
- 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<sup>3</sup> 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 1,453,600 tons that grade 0.317 oz/ton Au, 1.37 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 **Magnetite Cove** - Massive magnetite-skarn deposit; grades of up to 30 percent Fe reported; also contains Zn-Cu-Ag mineralization.
- 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 1 to 5 billion tons of material that contain 11 to 20 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 0.026 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.
- 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 **Sundum** - 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.

APPENDIX F — Continued

Year	Gold		Silver		Mercury		Antimony		Tin		Lead		Platinum		Copper		Chromium	
	(oz)	(md)	(oz)	(td)	(flask <sup>b</sup> )	(td)	(lb)	(td)	(lb)	(td)	(tons)	(td)	(oz)	(td)	(lb)	(md)	(tons)	(td)
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	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	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	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
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 <sup>c</sup>	0.56	1,000	2.0	125	44.0	160,000	185.0	W	W	—	—	W	W	—	—	—	—
1973	15,000 <sup>c</sup>	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 <sup>c</sup>	2.56	1,500	3.5	70	52.5	80,000	95.0	W	W	—	—	W	W	—	—	—	—
1975	14,980 <sup>c</sup>	3.35	6,000	25.0	—	—	120,000	145.0	22,000	60.0	—	—	W	W	—	—	—	—
1976	22,887 <sup>c</sup>	6.90	6,500	24.0	—	—	160,000	165.0	W	W	14	6.0	W	W	—	—	8,000 <sup>e</sup>	1,200.0 <sup>e</sup>
1977	50,000	7.80	8,000	20.0	—	—	W	W	W	W	—	—	—	—	—	—	—	—
1978	60,000 <sup>c</sup>	12.00	6,000	50.0	—	—	W	W	W	W	—	—	—	—	—	—	—	—
1979	65,000 <sup>c</sup>	18.00	6,500	93.0	—	—	100,000	125.0	100,000	830.0	—	—	—	—	—	—	—	—
1980	75,000 <sup>c</sup>	32.00	7,500	111.0	—	—	—	—	120,000	984.0	31	29.0	—	—	—	—	—	—
1981	134,200 <sup>c</sup>	55.20	13,420	111.3	W	W	—	—	106,000	700.0	—	—	900	200.0	—	—	—	—
1982	175,000 <sup>c</sup>	69.90	22,000	198.0	—	—	—	—	198,000	1,365.0	—	—	W	W	—	—	—	—
1983	169,000 <sup>c</sup>	67.60	33,200	332.0	—	—	22,400	45.0	215,000	1,100.0	—	—	W	W	—	—	—	—
1984	175,000 <sup>c</sup>	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 <sup>c</sup>	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	W	W	—	—	288,000	460.0	—	—	W	W	—	—	—	—
Other <sup>d</sup>	—	—	—	—	1,438	W	—	—	—	—	—	—	333,936	46,940.3	—	—	—	—
TOTAL	31,700,612	1,321.45	19,969,895	15,769.3	40,945	9,910.5	11,070,800	6,655.1	6,707,400	10,622.9	26,300	3,014.8	668,497 <sup>e</sup>	65,792.1	1,373,793,932	228.04	39,051	3,426.7

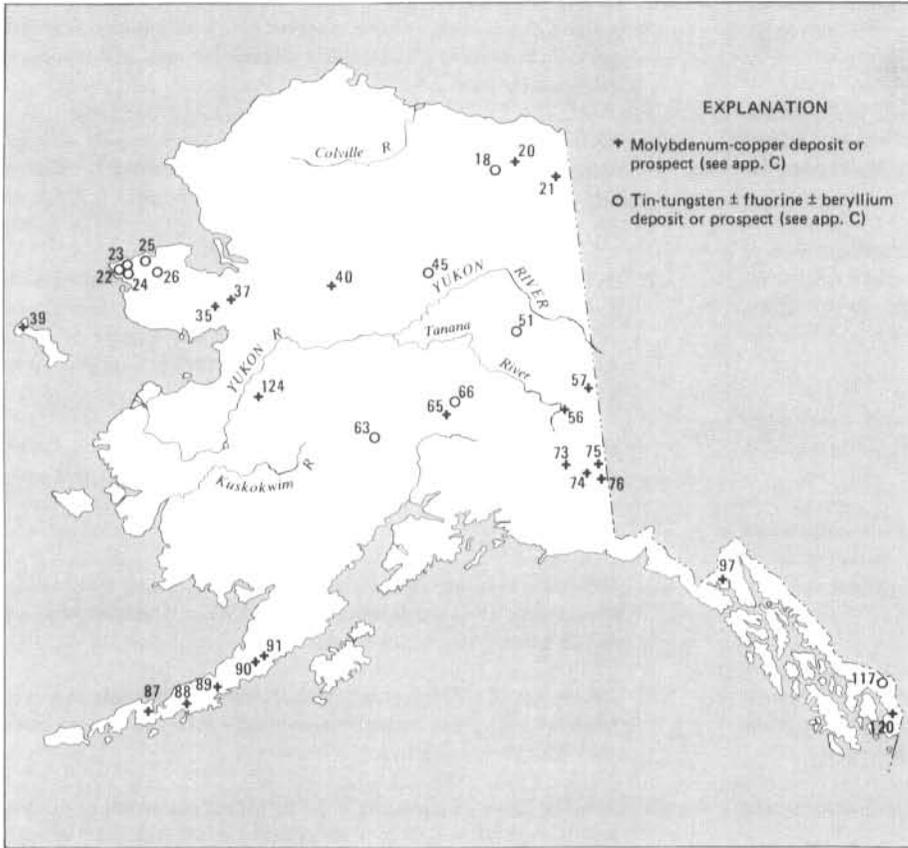


Figure 48. Locations of significant copper, lead, zinc ± silver, gold, and barite deposits in Alaska, 1988.

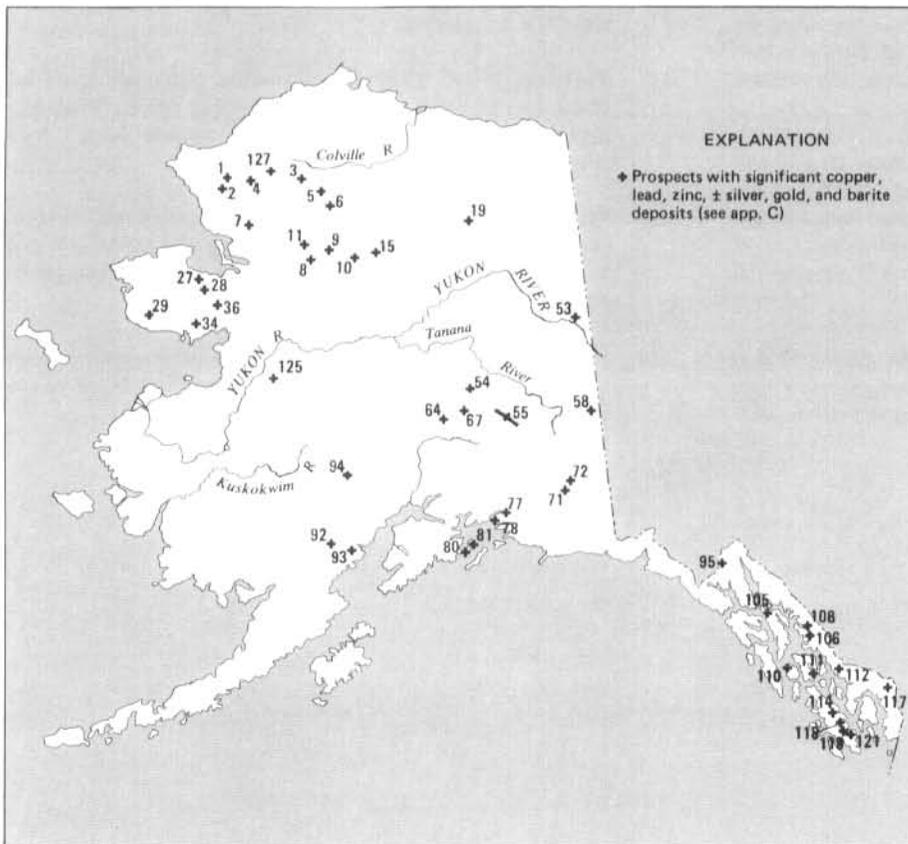


Figure 49. Locations of significant molybdenum-copper; and tin-tungsten ± fluorine and beryllium deposits in Alaska, 1988.

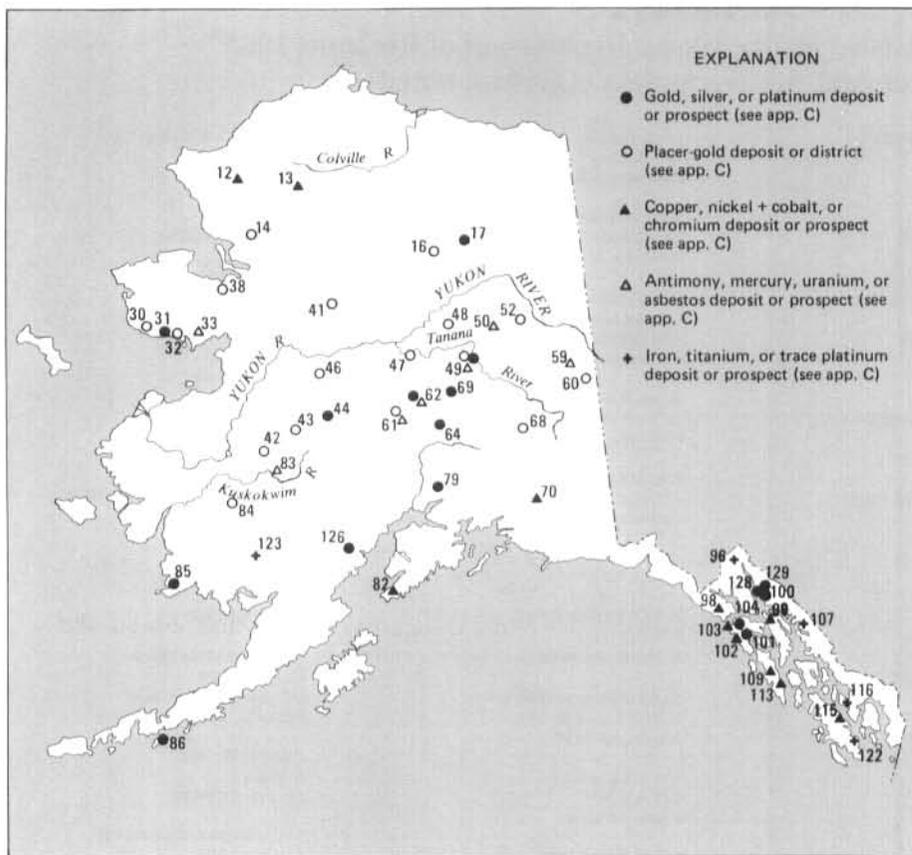


Figure 50. Location of significant gold, silver, platinum, and strategic mineral deposits in Alaska, 1988.

**APPENDIX D**  
**Mining licenses issued by the Alaska Department of Revenue, 1988<sup>a</sup>**  
**(placer gold + silver unless otherwise noted)**

AAP MINING P.O. Box 1230 Nome, AK 99762	ANNASARA ENTERPRISE Frank Towse Box 2194 Fairbanks, AK 99709	LYLE BEECROFT P.O. Box 513 Glennallen, AK 99588	DONALD D. BROWN Box 1313 Kenai, AK 99611 (gravel)
ROLAND ACHMAN P.O. Box 61185 Fairbanks, AK 99706	ANVIL MINING, INC. 1705 Ship Ave. Anchorage, AK 99501 (gravel)	DICK BEEMAN 2289 Franklin St. Fairbanks, AK 99709	MIRIAM K. BROWN Box 1313 Kenai, AK 99611 (gravel)
ALASKA AGGREGATE CORPORATION (4) 240 W. 68th Ave. Anchorage, AK 99518 (sand and gravel)	ROBERT APPLEBEE 4010 Merrill Dr. Anchorage, AK 99517	W.J. BEERMAN c/o Dan Livermore 3302 Dorbrandt Anchorage, AK 99503	OPAL J. BRUHN P.O. Box 8022 Nikiski, AK 99635
ALASKA APOLLO GOLD MINE, LTD. (2) c/o Paul Jones P.O. Box 304 Sand Point, AK 99661	ARCTIC KNIGHTS MINING CO. P.O. Box 60675 Fairbanks, AK 99706	EARL H. BEISTLINE P.O. Box 80148 Fairbanks, AK 99708	T.L. BRYANT P.O. Box 921 Coldfoot, AK 99701
ALASKA CONSTRUCTION & MINING Box 45 McGrath, AK 99627	ASHTON MINING ALASKA, INC. 550 W. 7th Ste. 1500 Anchorage, AK 99501	J.W. BELFIELD & R.J. HENRICKS P.O. Box 1944 Fairbanks, AK 99707	BUGLI MINING & EQUIPMENT <sup>b</sup> P.O. Box 21 Soldotna, AK 99669
ALASKA GOLD CO. (3) Box 640 Nome, AK 99762	AURORA MINING Lester Lines P.O. Box 10-3820 Anchorage, AK 99510	BERG-WETLESEN (3) Candle, AK 99728	ROBERT A. BURGIN P.O. Box 343 Sutton, AK 99674
ALASKA PLACER DEVELOPMENT, INC. Karl Hanneman P.O. Box 81467 Fairbanks, AK 99708	BTW MINING & EXPLORATION CORP. 4640 E. 113th Ave. Anchorage, AK 99516	H. CLARKE BILLINGS P.O. Box 81117 Fairbanks, AK 99708	BURKE ENTERPRISES Alan T. Chaffin 3275 Steese Hwy., 16 Mile Fairbanks, AK 99710-0531
ALASKA UNLIMITED CO. P.O. Box 60782 Fairbanks, AK 99706	PAUL I. BARELKA 1215 9th Ave. Fairbanks, AK 99701	BLACK SANDS MINING CO. 1156 W. Lone Cub Dr. Wasilla, AK 99687	JOHN R. BURNS P.O. Box 5 Chicken, AK 99732
ALASKA GOLD, INC. 7750 King St. Anchorage, AK 99502	GLENN BASS Box 241 Taos, NM 87571	PATRICK J. BLIFF General Delivery Unalakleet, AK 99684	PAUL BUSH & ED GROVER P.O. Box 4-1455 Anchorage, AK 99509
ALDER CREEK MINES <sup>b</sup> 1213 Coppet Fairbanks, AK 99709	HAROLD HOWARD BATTIST 912 6th Ave. Fairbanks, AK 99701	ROBERT WAYNE BLONDEAU Box 602 Valdez, AK 99686	BUSHMASTER MANAGEMENT P.O. Box 774409 Eagle River, AK 99577
ALLOYED ASSOCIATES, INC. P.O. Box 2295 Pocatello, ID 83206	BATTLE MOUNTAIN GOLD CO. 600 W. 58th Unit J Anchorage, AK 99518	RON BLOOM P.O. Box 114 Central, AK 99730	RICHARD BUSK Northern Bonanza P.O. Box 100971 Anchorage, AK 99510
ALYESKA OIL & EXPLORATION (3) Glenn Couch P.O. Box 737 Tok, AK 99780	TOD BAUER Box 871502 Wasilla, AK 99687	HAROLD A. NEVERS Bluewater Mining Co. 8148 Pine Wood Dr. Juneau, AK 99801	ROBERT B. BUTT 3007 S Circle Anchorage, AK 99507
ANCHORAGE SAND & GRAVEL CO., INC. 1813 East First Ave. Anchorage, AK 99501 (sand and gravel)	JOHN H. BAYLESS Box 28 Chicken, AK 99732	BOULDER CREEK MINING CO. Les Fickes P.O. Box 2618 Fairbanks, AK 99707	ROBERT CACY Box 106 Central, AK 99730
ALLAN G. ANDERSON Dog St. Alley Takotna, AK 99675	BEAVER LOOP SAND & GRAVEL (2) Mary J. Doyle Star Route 1 P.O. Box 1225 Kenai, AK 99611 (sand and gravel)	GLENN D. & LELA BOUTON 665 Farmers Loop Rd. Fairbanks, AK 99712	CAMP CREEK MINING Boundary, AK 99790
WAYNE S. ANDERSON 1901 Cheechako Dr. Fairbanks, AK 99709	BEAVER STATE MINE'S Richard J. McCallum Box 138 Fairbanks, AK 99701 (tin)	PAMELA J. KLESSIG BP Minerals America Inc. 4600 Kietzke Ln., Bldg. L Reno, NV 89502	CANDLE MINING CO. General Delivery Candle, AK 99728
ANNABELLE MINE James Roland 710 McGrath Rd. Fairbanks, AK 99712	BEE HIVE MINING Layne Gardner 284 Cindy Dr. Fairbanks, AK 99701	DONALD BRAGG 3605 Arctic #561 Anchorage, AK 99503	CAPITAL ENTERPRISES, INC. P.O. Box 20458 Denver, CO 80220
		BROKEN SHOVEL MINING CO. General Delivery Chicken, AK 99732	CARLO & SONS MINING CO. 2113 Southern Fairbanks, AK 99701
			CASTLE CREEK MINES P.O. Box 83557 Fairbanks, AK 99708

<sup>a</sup> Only licenses for 1988 that were received by DGGS-DOM (Fairbanks) by January 15, 1989 are listed.

<sup>b</sup> Numbers in parentheses indicate the number of separate mining licenses issued to a single individual, partnership, or company. In 1988, 438 licenses were issued to 398 operators. In 1987, 572 licenses were issued to 497 operators, and in 1986, 592 licenses were issued to 487 operators.

CASTLE RIDGE MINING CO. (2) Russ Miller 5955 Liberty Court Wasilla, AK 99687	CONGDON CONSTRUCTION & MINING Carl J. Congdon 925 Commerce St. Fairbanks, AK 99701	DOMA CREEK MINING & DEVELOPMENT Box 711 Wrangell, AK 99929	FLAT PICK MINING P.O. Box 118 Central City, AK 99730
ELLIS DUANE CHAMBLISS P.O. Box 31 Chicken, AK 99732	DAVID ALAN CONKLIN HC31, Box 5233 Wasilla, AK 99687	DOUBLE D MINING P.O. Box 61537 Fairbanks, AK 99706	FORTUNE MINING CO. OF AK P.O. Box 872172 Wasilla, AK 99687
LEONARD CHASE 641 East View Dr. Fairbanks, AK 99712	JOHN COOK P.O. Box 393 Fairbanks, AK 99707	ASA DOWDY, JR. 1051 Eastwood Ln. Fairbanks, AK 99701	CURTIS J. FREEMAN P.O. Box 74261 Fairbanks, AK 99707
CHICKAMAN MINING CO. Box 66 Chicken, AK 99732	LONNIE E. COOK Plaza 7, #142 Box 2117 Eagle River, AK 99577	DOXAUCO MINING Box 77 Central, AK 99720	LYNDON F. FUNK 551 Funk Rd. Fairbanks, AK 99712
LORENA N. CHRISTIE Sweet Willie P.O. Box 801 Kodiak, AK 99615	FRANK A. COUCH James Craig Porter Box 72 Soldotna, AK 99669	DUGGER MINING CO. Michael Dugger P.O. Box 115 Central, AK 99730	GHD RESOURCES PARTNER, LTD. P.O. Box 10499 Fairbanks, AK 99710
CHULITNA FORKS PLACER MINING 743 East Ninth Ave. Anchorage, AK 99501	JAMES ASHLEY CRABB Mile 128 Steese P.O. Box 10 Central, AK 99730	ECLIPSE MINING CO. INC. (2) P.O. Box 2318 Sequim, WA 999382	MARK A. GAEDE P.O. Box 2192 Soldotna, AK 99669
CHARLES W. CLEVELAND 10520 Azalea Glen Rd. Glendale, OR 97442	BERT CRAIGEN M&P Ltd. P.O. Box 24 Chicken, AK 99705	ELDORADO MINING CORPORATION R.C. Sheardown 3512 Campbell Airstrip Rd. Anchorage, AK 99504	GAME CREEK MINING CORPORATION 420 Ocean View Dr. Anchorage, AK 99515
DR. DON BRYANT Coastal Development Corporation 99 S. Dawning Denver, CO 80209	BILL CROLEY Box 191 Tok, AK 99780	MAHMOUD ELJAOUHARI P.O. Box 104442 Anchorage, AK 99510	DENNIS GARRETT c/o Empire Exploration, Inc. 10816 NE 17th Oklahoma City, OK 73141
GOLD CACHE MINING CO. 695 Roberts Roost Rd. Fairbanks, AK 99712	CURATOR AMERICAN, INC. John Barnett 1675 Broadway, Ste. 2430 Denver, CO 80202	LEWIS GIBSON ELMER c/o Poston SR Box 250 Gakona, AK 99586	STANLEY & EDWIN GELVIN P.O. Box 94 Central, AK 99730
JOHN H. COLE P.O. Box 10139 Fairbanks, AK 99710	D & K MINING Debbie Dale 3644 Bumpy Rd. North Pole, AK 99705	ENGSTROM DREDGING CO. Box 536 Nome, AK 99762	GERAGHTY MINING 405 Juneau Ave. Fairbanks, AK 99701
LYLE COLLEGE P.O. Box 60478 Fairbanks, AK 99706	DEPEM 105 Dunbar Ave. Fairbanks, AK 99701	KRISTER ERIKSSON P.O. Box 872809-199 Wasilla, AK 99687	WAYNE EUGENE GIBSON 1610 Southern Fairbanks, AK 99701
COLLINSVILLE MINING CO. Joe Bryant SR 5173J Wasilla, AK 99687	D.R. LAX CONSTRUCTION CO. David R. Lax Box 141 Naknek, AK 99633	ARVID ERLANDSON Rt. 1, Box 105 Whitesboro, TX 76273	WILLIAM E. GIRARD 8801 Tempest Circle Anchorage, AK 99507
COMINCO ALASKA EXPLORATION (2) Helen Farnstrom 139 E. 51st Ave. Anchorage, AK 99503	DELIMA PLACERS Don DeLima Manley Hot Springs, AK 99756	EVECO, INC. 1818 Old Steese Hwy. North Fairbanks, AK 99712	GIRDWOOD MINING CO. Gary McCarthy 3005 Arctic Blvd., #476 Anchorage, AK 99503
COMINCO ALASKA EXPLORATION Roy McMichael 139 E. 51st Ave. Anchorage, AK 99503	DEMPSEY MINING & CONSTRUCTION P.O. Box 790 Valdez, AK 99686	THOMAS E. FAA SR Mile 260 Parks Hwy. Healy, AK 99743	CARL GLANVILLE SCR Box 1195 Anchor Point, AK 99556
COMINCO ALASKA EXPLORATION Madelyn Millholland 139 E. 51st Ave. Anchorage, AK 99503	PAUL E. DENNEY 218 6th Ave. Fairbanks, AK 99701	FAIRBANKS EXPLORATION INC. (8) P.O. Box 82549 Fairbanks, AK 99708	GLENN MINING CO. Manley Hot Springs, AK 99756
COMINCO ALASKA EXPLORATION Phil St. George 139 E. 51st Ave. Anchorage, AK 99503	DENIS L. DEWANE Box 2396 Seward, AK 99664	FAIRBANKS SAND & GRAVEL, INC. P.O. Box 686 Fairbanks, AK 99707 (sand and gravel)	GOLDEN EAGLE MINING CO. Joseph Boursaw 3356 E. Evans Dr. Phoenix, AZ 85032
COMINCO ALASKA INCORPORATED 5660 B St. Anchorage, AK 99518 (zinc and lead)	ROY A. DIEHL 5941 Arctic, Unit B Anchorage, AK 99518	GARY & BRIAN FELDMAN 2011 Central Ave. Fairbanks, AK 99701	GOLDEN SLIPPER II Lau Josua 237 Ina Fairbanks, AK 99701
COMPASS MINING CO. P.O. Box 2700 Fairbanks, AK 99707	PAUL DIONNE via Coldfoot Wiseman, AK 99701	FELTON CONSTRUCTION CO. P.O. Box 7099 Missoula, MT 59807 (gravel)	GOLDDIGGERS 3515 Industrial Ave. Fairbanks, AK 99701
	PAUL H. DIONNE Wiseman, AK 99701	HOWARD R. FISHER P.O. Box 406 Kasilof, AK 99610	GOLDPOST MINING CO. P.O. Box 23 Central, AK 99730
		FLAT CREEK PLACERS Flat, AK 99584	GOLDSTREAM EXPLORATION P.O. Box 80772 Fairbanks, AK 99708

- GOLDSTREAM MINING  
2700 Hanson Rd.  
Box 80772  
Fairbanks, AK 99708
- GOLDUST MINES (2)  
Box 2151  
Fairbanks, AK 99707
- RICHARD GOODSON  
Box 12  
Chicken, AK 99732
- HANK GRADNEY  
P.O. Box 7440  
Fairbanks, AK 99707
- GRATEFUL DOG MINING CO.  
1563 Jones Rd.  
Fairbanks, AK 99709
- JAMES R. MOODY  
Gravest, Inc.  
4300 E. 3rd  
Anchorage, AK 99508
- GREAT AMERICAN MINING  
P.O. Box 1777  
Fairbanks, AK 99707
- GREATLAND EXPLORATION LTD.  
R.C. Sheardown  
3512 Campbell Airstrip Rd.  
Anchorage, AK 99504
- GORDON STUART GREBE  
Box 116  
Anchor Point, AK 99556
- GREEN MINING & EXPLORATION  
Douglas Green  
P.O. Box 61455  
Fairbanks, AK 99706
- GREENS CREEK MINING CO.  
Robert L. Bernhart, Jr.  
3000 Vintage Blvd., Ste. 200  
Juneau, AK 99801  
(various)
- MARK GUMAER  
2702 Gambell St., #200  
Anchorage, AK 99503
- JAMES P. HAGGLAND  
Box 81464  
Fairbanks, AK 99708
- HAM MINING CO.  
P.O. Box 65  
Chicken, AK 99732
- CHARLES R. HAMMOND  
General Delivery  
Chicken, AK 99732
- G.A. HANKS & SONS  
General Delivery  
Chicken, AK 99732
- G.A. HANKS & SONS  
Box 2533 Hwy. 16  
W. Sacramento, CA 95691-2098
- BARNEY HARROD  
1875 Arctic Loon Circle  
Fairbanks, AK 99709
- DONALD S. HART  
Rt. 1, Box 189  
Banks, OR 97106
- MICHAEL GEORGE HARTMAN  
2876 Monarch Rd.  
Fairbanks, AK 99712
- SCOTT HASKINS & RUDY VETTER  
147 Kelsan Way  
Fairbanks, AK 99709
- EDWIN L. HATCH  
Box 1801  
Nome, AK 99762
- HAYDEN EXPLORATION & MINING  
P.O. Box 110930  
Anchorage, AK 99511
- HEFLINGER MINING &  
EQUIPMENT CO.  
665 10th Ave., #307  
Fairbanks, AK 99701
- HELEN WARNER MINING  
P.O. Box 60610  
Fairbanks, AK 99708
- HERNING EXPLORATION & MINING  
P.O. Box 73846  
Fairbanks, AK 99707
- MARTIN M. & JEAN HERZOG  
14250 Sabine St.  
Anchorage, AK 99516
- CLIFFORD J. HOFF  
Benjamin Harvey Cowart  
2260 Tasha Dr.  
Anchorage, AK 99502
- HOFFMAN MINING  
HC 60, SRB Box 153  
Copper Center, AK 99573
- HOMER & WILLIAM HOOGENDORN  
P.O. Box 84  
Nome, AK 99762
- ALF HOPEN  
Box 74246  
Fairbanks, AK 99707
- CONRAD H. HOUSE  
924 Kellum, #101  
Fairbanks, AK 99701
- LEE HOUSE  
P.O. Box 473  
Nome, AK 99762
- KENNETH A. HUGHES III  
Box 586  
Teller, AK 99778
- H.M. HUMPHREY  
P.O. Box 1920  
Fairbanks, AK 99707
- HUNTER CREEK MINE  
Box 80321  
Fairbanks, AK 99708
- INTERIOR ALASKANA ASSOC. (2)  
Richard L. Loud  
742 Bennet Rd.  
Fairbanks, AK 99712
- JAMES W. CUDE MINING  
James W. Cude  
P.O. Box 876  
Pleasanton, TX 78064
- GEORGE H.R. JENNINGS  
P.O. Box 142953  
Anchorage, AK 99503
- DANIEL D. JENSEN  
P.O. Box 12  
Delta Junction, AK 99737
- O.J. JILES  
5250 Auburn-Folsom Rd.  
Loomis, CA 95650
- BRIAN C. JOHNSON  
21132 NE 108th  
Redmond, WA 98052
- JONES & CO.  
Milepost 49-3/4  
Anchorage & Sad. Hwy.  
Moose Pass, AK 99631
- JUNEAU BOWL MINING CO.  
2418 E. 86th Court  
Anchorage, AK 99507
- K & K MINING CO.  
10841 Livingston St.  
Anchorage, AK 99516
- K.C. MINING CO.  
Kenneth Hanson  
P.O. Box 10657  
Fairbanks, AK 99710
- K.L.K. INC.  
HCO 4, Box 9070  
Palmer, AK 99645
- KACHEMAK MINING CORP. (2)  
Mike Busby  
47660 Falls Creek Dr.  
Homer, AK 99603
- DAVID PENZ  
Kake Mine  
Russian Mission, AK 99657
- ALBERT W. KANGAS  
Box 1  
Ruby, AK 99768
- KAVIC MINING CO.  
P.O. Box 149  
Tok, AK 99780
- RON KIERSTAD  
c/o Charter Resources, Inc.  
10 Exchange Place, Ste. 610  
Salt Lake City, UT 84111
- RANDY KIRBY/LARRY VANCE  
P.O. Box 82741  
Fairbanks, AK 99708
- CLIFF KNOWLTON  
2207 John Evans Ln.  
Fairbanks, AK 99712
- LOUIS KNUDSEN  
1013 E. Dimond Blvd.  
Box 166  
Anchorage, AK 99515
- RICHARD KNUDSON  
210168  
Anchorage, AK 99521
- MARK KRENZKE  
P.O. Box 422  
Nenana, AK 99760
- KRISTI-PHYLEE MINING  
James M. Parry  
P.O. Box 1656  
Fairbanks, AK 99707
- KURT'S CONSTRUCTION  
1900 Granite View Dr.  
Delta Junction, AK 99737  
(gravel)
- L & B MINING  
1015 10th Ave.  
Fairbanks, AK 99701
- LBMB MINING CO.  
P.O. Box 189  
Bethel, AK 99559
- ROBERT J. LACOCK  
P.O. Box 713  
Nome, AK 99762
- HOWARD LAMBERT  
P.O. Box 87  
Ester, AK 99725
- GUST L. LARSON  
2102 Blueberry  
Anchorage, AK 99501
- JUANITA LARSON  
9499 Brayton Dr., #116  
Anchorage, AK 99507
- RAY LESTER  
732 Old Steese Hwy., #8  
Fairbanks, AK 99712
- LILLIAN CREEK MINE, INC.  
P.O. Box 60334  
Fairbanks, AK 99706
- LINDPHIL MINING CO.  
W. Phillips, S. Lindskoog  
P.O. Box 3304  
Homer, AK 99603
- LITTLE SQUAW GOLD MINING  
COMPANY  
P.O. Box 184  
Spokane, WA 99210
- GEORGE D. LIVERMORE (2)  
3302 Dorbrandt, #4  
Anchorage, AK 99503
- LOST RIVER MINING  
P.O. Box 411  
Nome, AK 99762
- LINDY LOUDERMILK  
Floyd Howell  
2231 W. Marston  
Anchorage, AK 99517
- MARIN LOVS  
2326 St. Elias Dr.  
Anchorage, AK 99517
- DONALD L. LUCAS  
1803 Kepner Ave.  
Anchorage, AK 99504
- LUCKY CREEK MINE  
P.O. Box 547  
Girdwood, AK 99587
- LUCKY 7 MINING CO.  
Ron Roman  
P.O. Box 1614  
Fairbanks, AK 99707
- LYMAN RESOURCES IN  
ALASKA, INC.  
Box 192  
McGrath, AK 99627
- M & M MINING  
Rod Mitchell  
3133 Chena Hot Springs Rd.  
Fairbanks, AK 99712
- MVM & ASSOCIATES  
P.O. Box 274  
Delta Junction, AK 99737
- JOSEPH MALATESTA, SR.  
P.O. Box 318  
Clam Gulch, AK 99568

MANIA MINING  
236 Farewell  
Fairbanks, AK 99701

MICK & CECILIA MANNS  
55 Mile  
Betles, AK 99726

MARTIN MINES  
Ed & Glen Martin  
P.O. Box 521  
Copper Landing, AK 99572

MASCOT MINING  
County Rd. 1, Box 264  
Ridgway, CO 81432

DIANE ELIZABETH MATHIESEN  
2261 Belmont Dr.  
Anchorage, AK 99517

MARK D. MATTER  
P.O. Box 44  
Aniak, AK 99557

MAXWELL MINE & EXPLORATION  
3910 Loc Sault Ave.  
Anchorage, AK 99516

MERRILL M. McGAHAN  
McGahan Enterprises  
Box 8548  
Nikishka, AK 99635  
(gravel, sand, etc.)

RICHARD LEE McINTOCH  
212 Wedgewood Dr.  
Fairbanks, AK 99701

GARRY N. McISAAC  
P.O. Box 531  
Abbotsford, BC, Canada V2S 5Z5

HOWARD F. McWILLIAMS  
P.O. Box 221603  
Anchorage, AK 99522

MESPELT & ALMASY MINING CO.  
Theodore J. Almasy/  
Margaret L. Mespelt  
Nixon Fork Mine  
McGrath, AK 99627  
(bismuth, uranium, etc.)

LEN MIKESSELL/JOE DAMEWOOD  
307 3rd Ave.  
Fairbanks, AK 99701

FRED D. WILKINSON  
Miller Creek Mining Co.  
P.O. Box 1  
Central, AK 99730

MINEX ALASKA INC.  
P.O. Box 103  
Girdwood, AK 99587

MISCOVICH MINING CO.  
P.O. Box 262  
Galena, AK 99741

ANDREW W. MISCOVICH  
Box 1489  
Fairbanks, AK 99707

JOHN A. MISCOVICH  
General Delivery  
Flat, AK 99584

JOHN R. MITCHELL  
P.O. Box 74947  
Fairbanks, AK 99707

MONTE CHRISTO MINING INC.  
P.O. Box 1073-Station A  
Vancouver, BC, Canada V6C 2P1

JOHN MOORE & EARL VOYTILLA (2)  
P.O. Box 82524  
Fairbanks, AK 99708

GEORGE A. MORRIS  
2783 Bonanza Trail  
Fairbanks, AK 99709

DAVID JOHN MOSS  
P.O. Box 681  
Tok, AK 99870

MRAK PLACER MINE  
P.O. Box 1963  
Palmer, AK 99645

DONALD E. MULLIKIN (2)  
P.O. Box 790  
Homer, AK 99603

JACK V. MURPHY  
P.O. Box 594  
Valdez, AK 99686

JIM MYERS  
P.O. Box 201306  
Anchorage, AK 99520

PAUL W. NELSON  
Rt. 2, Box 753  
Soldotna, AK 99669

JACK NEUBAUER  
Manley Hot Springs, AK 99756

NEWMONT EXPLORATION LTD.  
200 W. Desert Sky Rd.  
Tucson, AZ 85737

MYRTICE D. NODEN  
Box 47  
Dillingham, AK 99576

JAMES H. NORCROSS  
Box 242  
Willow, AK 99688

WILLIAM H. NORDEEN  
Emma Creek  
Coldfoot, AK 99701

NORTH CREEK MINING  
P.O. Box 1168  
Fairbanks, AK 99707

VIRGIL NORTON  
P.O. Box 58135  
Fairbanks, AK 99711

ROSS NOVAK  
Wingette, Inc.  
935 Aurora Dr.  
Fairbanks, AK 99701

NUGGET ESTATE MINING CO. (2)  
P.O. Box 60430  
Fairbanks, AK 99706

OCTOBER MINING CO.  
P.O. Box 1434  
Nome, AK 99762

ALAN G. OLSON & VICTOR LOYER  
Box 165  
Palmer, AK 99645

STEVEN OLSON  
P.O. Box 58443  
Fairbanks, AK 99711

OXY MINERALS CORPORATION  
P.O. Box 300  
Tulsa, OK 74102

P AND P MINE  
2551 Peede Rd.  
North Pole, AK 99705

C.D. PARKER  
P.O. Box 40  
Chicken, AK 99769

PETE PASQUAL  
c/o Coldfoot  
Wiseman, AK 99701

CACY PATTON  
P.O. Box 1505  
Fairbanks, AK 99707

PAUL & CO.  
Paul Manuel  
Box 83102  
Fairbanks, AK 99708

MARION A. PAVEY  
4751 Drake  
Fairbanks, AK 99701

MAC PAYNE  
1079 Victor  
North Pole, AK 99705

DAVID J. PETRIAS  
P.O. Box 278  
Fairbanks, AK 99707

ARGILE E. PETTIT  
Box 2591  
Palmer, AK 99645

G.W. PETTY  
General Delivery  
Eagle, AK 99738

PHILLIPS MINING  
522 E. 10th, #9  
Anchorage, AK 99501

ANNA B. PHILO  
P.O. Box 22  
Houston, AK 99687

ROY PHILPOTT  
115 Charles St.  
Fairbanks, AK 99701

PLACID OIL CO.  
J.C. Jones  
3900 Thanksgiving Tower  
Dallas, TX 75201

POLAR MINING, INC. (2)  
4545 Woodrider Dr.  
Fairbanks, AK 99709

WILLARD B. POWERS  
P.O. Box 1441  
Santa Ana, CA 92702

PRINCE CREEK MINING CO.  
General Delivery  
Flat, AK 99584

11 PUP MINING  
Robert Bettisworth  
924 Kellum, #303  
Fairbanks, AK 99701

PURTEN/WAYSON  
999 Ballane Rd.  
Fairbanks, AK 99709

QUARTZ CREEK EXPLORATION CO.  
P.O. Box 242  
Sterling, AK 99672

RGU & BONANZA MINING  
P.O. Box 1587  
Fairbanks, AK 99707

RTM CO., INC.  
Albert M. Hagen  
General Delivery  
Manley Hot Springs, AK 99756

LINDY & LARRY RAINES  
1313 Skyline Dr.  
Fairbanks, AK 99712

RAY WOLD MINING  
P.O. Box 625  
Cave Junction, OR 97523

REBEL CREEK MINING  
HICO3, Box 8100-L  
Palmer, AK 99645

REGENT ALASKA INC.  
Robert A. Schenker  
1480-A Fritz Cove Rd.  
Juneau, AK 99801

LEO A. REGNER  
P.O. Box 2733  
Fairbanks, AK 99707

LYN RILL  
215 Ellingson  
Fairbanks, AK 99701

ROBERT ROBERTS  
Box 225  
Tok, AK 99780

ROBERTSON MINING CO.  
Clyde Brown  
5253 Calle Redonda  
Phoenix, AZ 85018

ROCK PRODUCTS, INC.  
P.O. Box 240008  
Anchorage, AK 99524  
(sand, gravel, and rock)

JOHN D. RUBEL  
8183 Richardwon Hwy.  
Salcha, AK 99714

RUSSELL MINING CO.  
487 E. Hemmi Rd.  
Lynden, WA 98264

ERNEST CARL RUSSELL  
General Delivery  
Manley Hot Springs, AK 99756

RYBACHEK MINE  
Stanley Rybachek  
P.O. Box 55698  
North Pole, AK 99705

S & H ENTERPRISE  
Roger Severson  
HCR 4, Box 180  
Deer River, MN 56636

SALTER ASSOCIATES  
General Delivery  
Manley, AK 99756

SAVAGE MINING CO.  
Manley Hot Springs, AK 99756

DWAYNE SAVAGE  
P.O. Box 10613  
Fairbanks, AK 99710

PAUL SAYER  
Box 10  
Homer, AK 99603

ROBERT A. SCHENKER  
P.O. Box 33037  
Juneau, AK 99803

- JOHN SCHNABEL  
P.O. Box 149  
Haines, AK 99827
- WERNER SCHUSTER  
2633 Seclusion Dr.  
Anchorage, AK 99504
- GEORGE W. SEUFFERT, JR.  
P.O. Box 156  
Central, AK 99730
- W.L. SHAFFER  
Box 13382  
El Paso, TX 79913
- W.L. SHAFFER  
316 Rio Verde  
El Paso, TX 79912
- JOHN SHATT  
5914 Hwy. 30 West  
The Dalles, OR 97058
- JOHN A. SHILLING  
Box 81424  
Fairbanks, AK 99708
- SHORT GULCH MINING CO., LTD.  
P.O. Box 9  
Ruby, AK 99768
- RALPH SIMONSON  
Rt. 2, Box 67A  
Elgin Ore, OR 97827
- JOHN WILSON SIMPSON &  
JOHN JAMES BRENNAN  
17147 Belarde  
Anchorage, AK 99516
- JOHN SIPES (2)  
2741 Perimeter  
North Pole, AK 99705
- SMITH BROTHERS MINING  
551 Eberhardt Rd.  
Fairbanks, AK 99712
- SMITH EQUITIES  
7100 Homer Dr.  
Anchorage, AK 99518
- SHERMAN C. SMITH  
Box 770  
Cooper Landing, AK 99572
- WILLIAM L. SMITH  
906 Cunningham  
Anchorage, AK 99501
- SNOW LION MINING CO. (2)  
General Delivery  
Haines, AK 99827
- HAROLD L. SOULE  
2840 E. 142nd Ave.  
Anchorage, AK 99516
- SPHINX MINING INC. (3)  
P.O. Box 81978  
Fairbanks, AK 99708
- SPRUCE CREEK MINING CO.  
Ophir  
McGrath, AK 99627
- STEPP A. LONG & VERNON STEPP  
290 Pearl Dr.  
Fairbanks, AK 99712
- JIM STEWARD  
835 Faulstich Ave.  
North Pole, AK 99705
- JACK J. STEWART  
2420 Jack Warren Rd.  
Delta Junction, AK 99737
- GEORGE R. STRICKLER  
16900 Ransom Ridge  
Anchorage, AK 99516
- GERALD STUDINAK  
352 Breeze Rd.  
Fairbanks, AK 99712
- JESSE SWAIN & FRANK LOUCH  
P.O. Box 525  
Sterling, AK 99672
- 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 A. SWENSON  
Box 16082  
Two Rivers, AK 99716
- WAYNE H. TACHICK  
P.O. Box 3503  
Soldotna, AK 99669
- KENNETH TAINTER  
Box 215  
McGrath, AK 99627
- A.J. TAYLOR  
407-1/2 D St.  
Fairbanks, AK 99701
- THE MINING CO.  
P.O. Box 74949  
Fairbanks, AK 99707
- THE MINING MANAGEMENT CORP.  
P.O. Box 91725  
Anchorage, AK 99501
- THE RESOURCE CO.  
Westley Childers  
P.O. Box 686  
Fall City, WA 98024
- JOHN C. THOMAS  
Tungsten Mining Co.  
P.O. Box 9023  
Coldfoot, AK 99701
- KEVIN THOMPSON (2)  
P.O. Box 875534  
Wasilla, AK 99687
- THREE G MINE  
Rt. 1  
Healy, AK 99743
- THURMAN OIL & MINING (2)  
925 Aurora Dr.  
Fairbanks, AK 99709
- ROBERT L. & SHIRLEY TITCHENAL  
7808 Honeysuckle Dr.  
Anchorage, AK 99502
- TOMMY VAN, INC.  
Tom C. Van Ostrand  
P.O. Box 314  
Healy, AK 99743
- CYNTHIA TOOHEY  
Box 113  
Girdwood, AK 99587
- ROBERT J. TOPOROWSKI  
Cook Inlet Region, Inc.  
3020 Davis, Apt. D6  
Fairbanks, AK 99709
- WALLACE M. TOUPE (2)  
3330 Industrial Ave.  
Fairbanks, AK 99701
- WALLACE M. TOUPE (2)  
5320 Decathlon Ave.  
Fairbanks, AK 99709
- JOHN JAMES TRAUTNER  
Box 909  
Girdwood, AK 99587
- TREASURE CREEK MINING (2)  
P.O. Box 1638  
Fairbanks, AK 99707
- TRI-CON MINING, INC.  
P.O. Box 83730  
Fairbanks, AK 99708
- ROBERT TUCKER  
3103 Rose St.  
Anchorage, AK 99508
- TULUKSAK DREDGING, LTD. (2)  
737 E St.  
Anchorage, AK 99501
- ELIZABETH S. TWEET  
1100 W. 32nd, #19  
Anchorage, AK 99503
- N.B. TWEET & SONS  
Box 503  
Teller, AK 99778
- OSCAR TWEITEN  
Box 162  
Fairbanks, AK 99707
- ALEX TWOGOOD  
P.O. Box 60203  
Fairbanks, AK 99706
- U OF A STATEWIDE OFFICE  
OF LAND MANAGEMENT  
3354 College Rd.  
Fairbanks, AK 99709
- DAVID UNDERWOOD  
Box 53  
Central, AK 99730
- BETTY K. VELIKANJE  
2600 Draper Dr.  
Anchorage, AK 99517
- D.B. VIAL & B.W. COMSTOCK  
General Delivery  
Candle, AK 99728
- MICHAEL L. VIAL  
P.O. Box 899  
Candle, AK 99728
- ANGEL C. VIDAL  
433 M St.  
Anchorage, AK 99501
- G.T. WACKER  
277787 Alberta Ltd.  
Box 6385  
Wetaskiwiw, Alberta, Canada T9A-2G3
- FRANK R. WARREN  
P.O. Box 11  
Central, AK 99730
- JIM WATKINS  
P.O. Box 2871  
Palmer, AK 99645
- DOUGLAS L. WEATHERS  
P.O. Box 8082  
Nikiski, AK 99635
- STEVE WEBER  
1096 Shoshone St.  
North Pole, AK 99705
- ANDREW G. WESCOTT  
1132 Lakeview Terrace  
Fairbanks, AK 99701
- WHITE BEAR  
H. Faulkner Sr., & Jeannine D.  
P.O. Box 1307  
Bethel, AK 99559
- WILD RIVER VENTURES  
Bettles Field, AK 99726
- FRANK E. & VIVIAN D. WILLFORD  
Box 10570  
Fairbanks, AK 99710
- WILBUR & ANN WILLIAMS  
Flat, AK 99584
- RICHARD C. WILMARTH (2)  
Box 33  
Red Devil, AK 99656
- WILSON MINING CO.  
Helen E. Wilson  
1624 E St.  
Anchorage, AK 99501
- GEORGE R. WILSON  
SRC Box 8360  
Palmer, AK 99645
- WINDFALL GOLD MINING CORP.  
P.O. Box 1929  
Nome, AK 99762
- WINDY BAR MINING  
P.O. Box 21  
Chicken, AK 99732
- LLOYD A. WOLFE &  
DALE L. JOHNSON  
251 Oak St.  
Wisconsin Rapids, WI 54494
- MORRIS D. WOLTERS  
746 Marine View Dr.  
Longview, WA 98632
- CHARLES B. WOODRUFF  
P.O. Box 2278  
Fairbanks, AK 99707
- RON WREDE  
2116 NE 80th St.  
Seattle, WA 98115
- JULES WRIGHT  
General Delivery  
Manley, AK 99756
- RICHARD L. WRIGHT  
3910 Tilleson Way  
North Pole, AK 99705
- LEWIS WYMAN  
General Delivery  
Chicken, AK 99732
- L.E. & MARILYN A. WYRICK  
P.O. 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)  
P.O. Box 101454  
Anchorage, AK 99510

YUTAN CONSTRUCTION CO.  
Carroll/Vondra  
P.O. Box 1775  
Fairbanks, AK 99707  
(basalt rock)

LES PAUL ZERBE  
356 Louise Ln.  
Fairbanks, AK 99709

GEORGE W. ZIMMER  
P.O. Box 140174  
Anchorage, AK 99514

JOSEPH D. ZIMMERMAN  
General Delivery  
Manley Hot Springs, AK 99756

## APPENDIX E

### Primary metals production in Alaska, 1880-1988<sup>a</sup>

Year	Gold		Silver		Mercury		Antimony		Tin		Lead		Platinum		Copper		Chromium	
	(oz)	(md)	(oz)	(td)	(flask <sup>b</sup> )	(td)	(lb)	(td)	(lb)	(td)	(tons)	(td)	(oz)	(td)	(lb)	(md)	(tons)	(td)
1880-1899	1,153,889	23.85	496,101	32.9	-	-	-	-	-	-	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 <sup>c</sup>	44.1 <sup>c</sup>	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	457,343	16.01	154,700	100.0	-	-	-	-	8,200 <sup>c</sup>	4.3	839	62.1	2,555	85.6	121,000	0.06	-	-
1935	455,429	15.94	286,600	206.0	-	-	-	-	98,800	49.8	815	65.2	8,685	259.6	15,056,000	1.25	-	-
1936	526,000	18.43	484,306	375.0	-	-	-	-	226,000	105.0	941	86.6	5,654	241.9	39,267,000	3.72	-	-
1937	582,085	20.37	494,340	382.0	-	-	962,000	147.6	372,000 <sup>c</sup>	202.3 <sup>c</sup>	823	97.1	9,823	313.4	36,007,000	4.74	-	-

<sup>a</sup> References from T.K. Bundtzen, DGGG, Fairbanks.

<sup>b</sup> 76-lb flask.

<sup>c</sup> When state and federal figures differ significantly, state figures are used.

<sup>d</sup> Not traceable by year.

<sup>e</sup> Crude platinum; total production of refined metal is about 575,000 oz.

W = Withheld.

- = Not reported.

td = Thousand dollars.

md = Million dollars.

Year	Gold		Silver		Mercury		Antimony		Tin		Lead		Platinum		Copper		Chromium	
	(oz)	(md)	(oz)	(td)	(flask <sup>b</sup> )	(td)	(lb)	(td)	(lb)	(td)	(tons)	(td)	(oz)	(td)	(lb)	(md)	(tons)	(td)
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	665,114	23.28	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	747,943	26.18	191,679	136.3	156 <sup>c</sup>	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 <sup>c</sup>	61.0 <sup>c</sup>	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 <sup>c</sup>	1.0 <sup>c</sup>	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	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	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	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
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 <sup>c</sup>	0.56	1,000	2.0	125	44.0	160,000	185.0	W	W	-	-	W	W	-	-	-	-
1973	15,000 <sup>c</sup>	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 <sup>c</sup>	2.56	1,500	3.5	70	52.5	80,000	95.0	W	W	-	-	W	W	-	-	-	-
1975	14,980 <sup>c</sup>	3.35	6,000	25.0	-	-	120,000	145.0	22,000	60.0	-	-	W	W	-	-	-	-
1976	22,887 <sup>c</sup>	6.90	6,500	24.0	-	-	160,000	165.0	W	W	14	6.0	W	W	-	-	8,000 <sup>c</sup>	1,200.0 <sup>c</sup>
1977	50,000	7.80	8,000	20.0	-	-	W	W	W	W	-	-	-	-	-	-	-	-
1978	60,000 <sup>c</sup>	12.00	6,000	50.0	-	-	W	W	W	W	-	-	-	-	-	-	-	-
1979	65,000 <sup>c</sup>	18.00	6,500	93.0	-	-	100,000	125.0	100,000	830.0	-	-	-	-	-	-	-	-
1980	75,000 <sup>c</sup>	32.00	7,500	111.0	-	-	-	-	120,000	984.0	31	29.0	-	-	-	-	-	-
1981	134,200 <sup>c</sup>	55.20	13,420	111.3	W	W	-	-	106,000	700.0	-	-	900	200.0	-	-	-	-
1982	175,000 <sup>c</sup>	69.90	22,000	198.0	-	-	-	-	198,000	1,365.0	-	-	W	W	-	-	-	-
1983	169,000 <sup>c</sup>	67.60	33,200	332.0	-	-	22,400	45.0	215,000	1,100.0	-	-	W	W	-	-	-	-
1984	175,000 <sup>c</sup>	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 <sup>c</sup>	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	-	-	-	-
Other <sup>d</sup>	-	-	-	-	1,438	-	-	-	-	-	-	-	333,936	46,940.3	-	-	-	-
TOTAL	31,966,112	1,434.29	20,017,685	16,051.3	40,945	9,910.5	11,070,800	6,655.1	7,007,400	11,572.9	26,300	3,014.8	668,522 <sup>c</sup>	65,805.9	1,373,793.932	228.04	39,051	3,426.7

**APPENDIX F**  
**Production of industrial minerals, coal, and other commodities in Alaska, 1880-1988<sup>a</sup>**

Year	Coal		Sand and gravel		Building stone <sup>b</sup>		Barite		Other <sup>c</sup> (dollars)
	(s. tons)	(md)	(s. tons)	(md)	(s. tons)	(md)	(s. tons)	(td)	
1880-1899	19,429 <sup>d</sup>	0.14 <sup>d</sup>	-	-	7,510	0.04	-	-	-
1900	1,200 <sup>d</sup>	0.20 <sup>d</sup>	-	-	510	0.01	-	-	-
1901	1,300 <sup>d</sup>	0.02 <sup>d</sup>	-	-	700	0.01	-	-	500
1902	2,212 <sup>d</sup>	0.02 <sup>d</sup>	-	-	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 <sup>d</sup>	0.01 <sup>d</sup>	-	-	2,176	0.03	-	-	81,305
1909	2,800	0.02	-	-	1,400	0.01	-	-	86,027
1910	1,000 <sup>d</sup>	0.01 <sup>d</sup>	-	-	W	W	-	-	96,408
1911	900 <sup>d</sup>	0.01 <sup>d</sup>	-	-	W	W	-	-	145,739
1912	355 <sup>d</sup>	0.01 <sup>d</sup>	-	-	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

<sup>a</sup>Production histories for most commodities are summarized in Bundtzen (1982), Bundtzen and Smith (1982), and Bundtzen and others (1982).

<sup>b</sup>Building-stone production figures for 1880-1937 are for the southcentral and interior regions of Alaska only.

<sup>c</sup>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).

<sup>d</sup>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.

<sup>e</sup>Production not traceable by year.

<sup>f</sup>Marble quarried on Prince of Wales Island, southeastern Alaska (1900-41).

W = Withheld.

- = Not reported.

td = Thousand dollars.

md = Million dollars.

Year	Coal		Sand and gravel		Building stone <sup>b</sup>		Barite		Other <sup>c</sup>
	(s. tons)	(md)	(s. tons)	(md)	(s. tons)	(md)	(s. tons)	(td)	(dollars)
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	-	-	-	-	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
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 <sup>d</sup>	5.88 <sup>d</sup>	5,600,000	5.10	54,000	0.20	-	-	1,338,000
1960	669,000 <sup>d</sup>	5.95 <sup>d</sup>	5,892,000	5.35	80,000	0.30	-	-	975,000
1961	650,000 <sup>d</sup>	5.87 <sup>d</sup>	5,241,000	4.19	-	-	-	-	-
1962	675,000 <sup>d</sup>	6.41 <sup>d</sup>	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 <sup>d</sup>	5.88 <sup>d</sup>	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 <sup>d</sup>	5.03 <sup>d</sup>	17,515,000	20.73	W	W	91,000	W	4,117,000
1969	728,000 <sup>d</sup>	4.65 <sup>d</sup>	16,205,000	18.62	1,954,000	3.90	90,000	850.0	5,163,000
1970	786,000 <sup>d</sup>	5.28 <sup>d</sup>	20,375,000 <sup>d</sup>	26.07 <sup>d</sup>	6,470,000	10.01	134,000 <sup>d</sup>	1,875.0	7,994,000
1971	748,000 <sup>d</sup>	5.05 <sup>d</sup>	26,391,000	41.99	2,658,000	5.07	102,000 <sup>d</sup>	1,075.0	-
1972	720,000 <sup>d</sup>	6.26 <sup>d</sup>	14,187,000	15.21	652,000	3.01	W	W	-
1973	700,000 <sup>d</sup>	6.23 <sup>d</sup>	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 <sup>d</sup>	240.94 <sup>d</sup>	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 <sup>d</sup>	30.0	12,731,000
1976	705,000	8.00	74,208,000 <sup>d</sup>	204.73 <sup>d</sup>	6,727,000	20.09	W	W	14,019,000
1977	780,000 <sup>d</sup>	12.00 <sup>d</sup>	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	803,000	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 <sup>f</sup>	24.65	-	-	389,000
Other <sup>e</sup>	-	-	-	-	2,300,000 <sup>f</sup>	W	79,000	W	-
TOTAL	37,504,730	499.93	1,011,460,584	1,981.88	86,806,836	312.94	856,000	11,417.0	173,238,872

*Back cover: Top--An arctic sunrise shines through the frame of the concentrate storage shed constructed in 1988 at the Red Dog port site on the Chukchi Sea in northwestern Alaska. The storage shed will hold nine months of zinc-lead-silver concentrate production from the Red Dog mine for shipment during the ice-free summer shipping season. Photo by Rob Stapleton, courtesy of Cominco Alaska, Inc., 1988.*

*Bottom left--Surveyor Bruce Schuld of Centennial Development takes a reading from his transit while doing underground surveying at the Alaska Juneau (AJ) mine in Juneau, Alaska. Echo Bay Mines is examining the feasibility of reopening this historic gold mine which operated from 1914 to 1944. Photograph by Lance Miller, courtesy of Echo Bay Exploration, 1988.*

*Bottom Center--The mill at the Greens Creek mine on Admiralty Island near Juneau was completed in 1988. The Greens Creek mine will become one of the largest silver producers in the nation and will also produce gold, zinc, and lead. Photograph by Ray Parker, courtesy of Greens Creek Mining Company, 1988.*

*Bottom Right--A rock hammer lies against the discovery outcrop at the Dream claim block staked by Juneau prospectors Roger Eichman, Dale Henkins, and Floyd Branson. The prospect is located in the Chilkat Mountains in southeastern Alaska and is operated by Curator American, Inc. The deposit contains gold, silver, cobalt, copper, lead, and zinc in massive sulfide mineralization and was discovered by Al Clough of the Juneau office of the U.S. Bureau of Mines. Photograph by John Barnett, 1988.*

