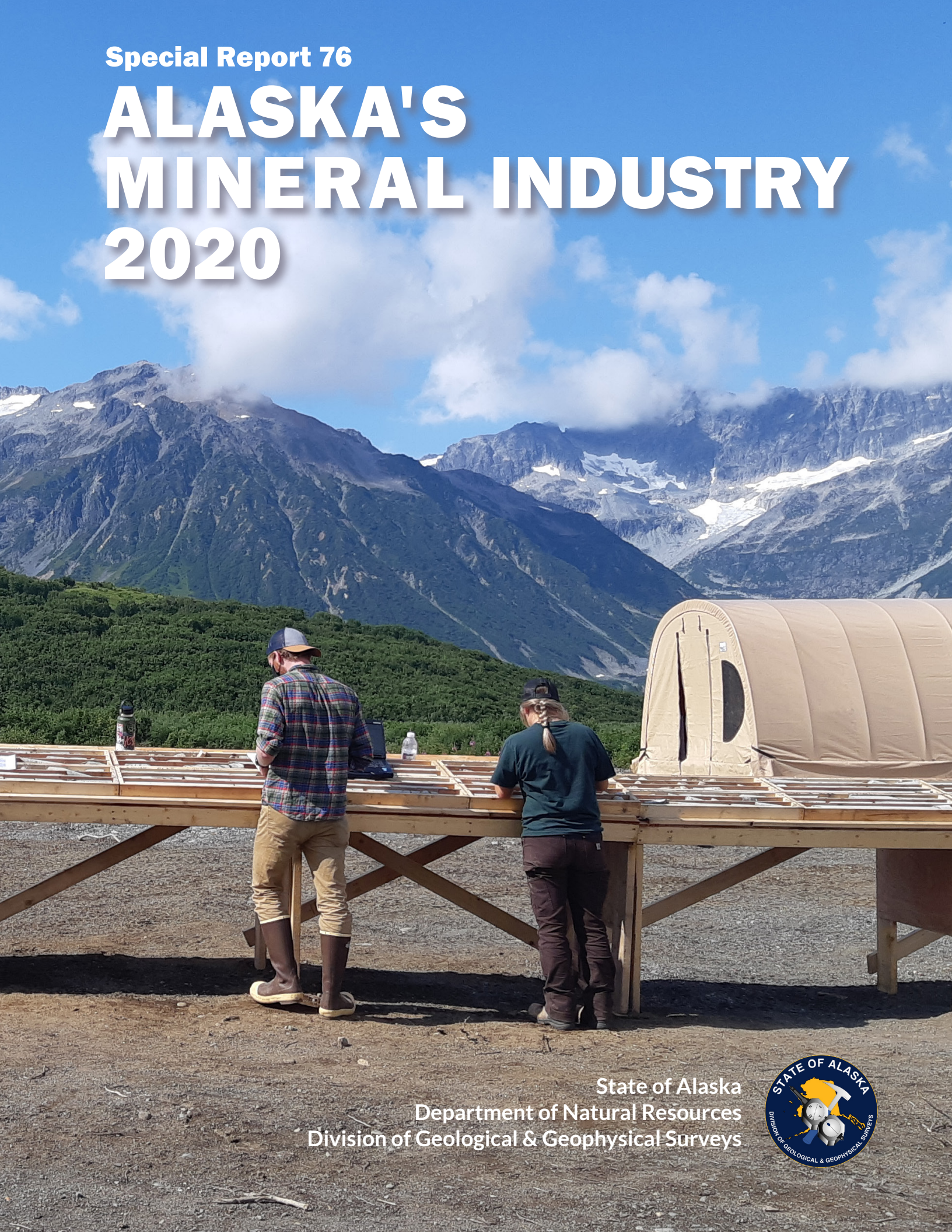
Special Report 76

ALASKA'S MINERAL INDUSTRY 2020



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Alaska's Mineral Industry 2020

Evan Twelker[1], Melanie B. Werdon[1], and Jennifer E. Athey[1]

Cover. Another beautiful day core logging at HighGold's Johnson Tract gold and base-metal property in south-central Alaska. Photo courtesy of Brodie Sutherland, HighGold Mining Inc.

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EXECUTIVE SUMMARY

This summary of the status of Alaska's mineral industry for 2020 is the 40th such annual report produced by the Department of Natural Resources, Division of Geological & Geophysical Surveys, and partner agencies. Published for more than one-third of a century, the annual report endeavors to provide a consistent and factual snapshot of mineral industry activity in Alaska. It also serves as the authoritative historical record of mining in the State.

The reported value of Alaska's mineral industry in 2020 totaled $3.2 billion, an increase of five percent from 2019. The total value for 2020 is a composite of the year's expenditures on exploration and development, plus the revenue to the operators from the commodities produced.

Alaska's mining industry delivered mixed results in 2020, as the emerging COVID-19 pandemic sent shockwaves through the global economy and disrupted planned projects. Despite the mining industry being declared an essential industry, many projects were scaled back, delayed, or operated with staffing challenges and costly quarantine measures. Zinc and lead prices sank with the slowing economy, but soaring gold and silver prices improved cashflow for Alaska's precious metal mines.

Zinc continued to be the top metal produced in 2020 by a slim margin, accounting for 41 percent of Alaska's total metal production despite a ten percent drop in production volume. Gold followed closely at 39 percent of total production, with total ounces produced up 11 percent and revenue up 38 percent. Production of silver and lead remained steady, but silver revenue rose, while revenue from lead fell due to price changes.

Development expenditures in Alaska fell 23 percent to $267.8 million in 2020. Currently, only capital expenditures at Alaska's operating mines are contributing to this category, which is sensitive to the timing of high-cost individual projects.

Mineral exploration expenditures fell 15 percent to $145.9 million, in line with global trends. Alaska's remote, summer-season exploration projects took a particularly strong hit from disruptions and uncertainty associated with the emerging COVID-19 pandemic, but the State's abundant, high-quality gold projects were well positioned to benefit from record gold prices and investor enthusiasm. Exploration spending on gold projects increased 45 percent to $100 million dollars in 2020.

Active mining claims and prospecting sites covered more than four million acres of Alaska in 2020, an increase of 15 percent from 2019. State mining claims, which account for 97 percent of the total claimed land, increased by 14 percent, while the total area of Federal mining claims increased by two percent in 2020.

Mineral industry employment fell modestly across all sectors in 2020, down eight percent to an estimated 3,225 full-time-equivalent jobs. The steepest loss in employment is tied to decreased capital spending at Alaska's operating mines.

Estimated revenues to the State of Alaska and municipalities from mineral-industry-specific fees, rents, sales, royalties, and taxes amounted to more than $119.1 million in 2020, a decrease of 17 percent from 2019.

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TRACKING ALASKA'S MINERAL INDUSTRY:

Estimated revenue to industry versus theoretical first market value

This report began a new method of tracking the value of Alaska's mineral production starting with the 2016 mining year.

'Estimated revenue to industry,' as reported voluntarily by mining companies, is now the primary method for tabulating annual mine production in Alaska; 'estimated first market value' figures tabulated prior to 2016 have now been more accurately retitled 'theoretical first market value' (table 1).

The new 'estimated revenue to industry' figure accounts for actual sales revenue, including the effects of stockpiling, price hedging, the price at the time of sale, smelting and refining charges, and transportation of the final product.

The 'theoretical first market value' figure simply reflects the total amount of each commodity produced multiplied by the average price for that year; the simplicity of this approach means that the theoretical first market value figure can significantly overstate the revenue realized by the operator. For example, there is approximately a $206 million difference between estimated revenue received by operators in 2020 and the theoretical first market value for 2020. When actual revenue values are either not voluntarily reported or must be withheld for reasons of confidentially, theoretical first market values will be used instead.

In the "Government Revenues from Alaska's Mineral Industry" section, gross income from mining operations as reported on Alaska Mining License Tax returns and explanatory text are also available for comparison with the estimated revenue to industry values from 2017–2019.

INTRODUCTION

Alaska's mineral potential is evident from its historically significant production: placer gold from the Fairbanks and Nome mining districts, copper from the Kennecott area, lode gold from the Alaska–Juneau (A–J) and Treadwell mines near Juneau, and placer platinum from the Goodnews Bay Mining District. Alaska's major deposits currently in production include Red Dog, Greens Creek, Pogo, Fort Knox, Kensington, and Usibelli Coal mines (photo 1). Alaska added an additional operating gold mine in 2019, the Dawson mine in southeastern Alaska. Promising advanced-exploration and permitting-phase projects include Donlin Gold, Pebble, Livengood, Niblack, Palmer, Arctic, Bornite, and Lik deposits. These deposits and others, found throughout Alaska's seven geographic regions defined for this report (fig. 1), collectively represent a significant proportion of United States' domestic gold, silver, copper, and base-metal resources. These deposits demonstrate that there are still extremely large mineral deposits to be developed in Alaska. Significant resources of other commodities include the advanced-exploration projects of Graphite Creek (graphite deposit) and Bokan Mountain (rare-earth-element deposit), promising future domestic sources of critical raw materials needed for twenty-first-century technologies. Without a doubt, Alaska holds other world-class mineral deposits yet to be discovered. **In 2020 Alaska was ranked 5th out of 77 worldwide jurisdictions for overall investment attractiveness by mining and exploration companies**, which takes into account geologic potential as well as government policy factors that affect exploration investment.[2]

It is the policy of the State of Alaska to encourage the settlement of its land and the development of its resources by making them available for maximum use consistent with the

Photo 1. A miner works in an ore heading at the Kensington mine near Juneau. Photo from Coeur Mining website last accessed December 6, 2021; www.coeur.com/operations/mines/kensington-alaska/#&gid=1&pid=12.

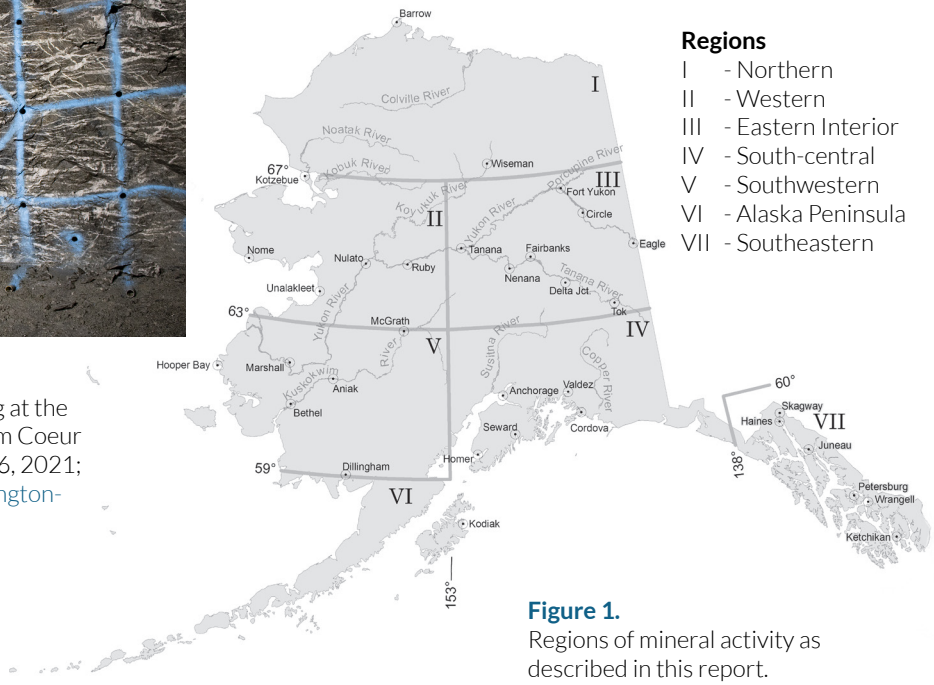


Figure 1.
Regions of mineral activity as described in this report.

[2]Yunis, Jairo, and Aliakbari, Elmira, 2020, Fraser Institute Annual Survey of Mining Companies, 2019: Fraser Institute, 78 p. www.fraserinstitute.org

public interest (appendix A). Alaska, in its strategic Pacific Rim location, offers prospective land, security of title, State-sponsored geological and geophysical mapping, a reasonable permitting process coordinated among agencies, a capable workforce, exploration incentives, and innovative infrastructure equity-sharing programs. More than 190 million acres of Federal, State, and Native-owned lands are open for mineral-related activities and mining. This allows the minerals industry to be a driving force in the State's economy through significant local employment, infrastructure, and government revenue.

Alaska's mining industry was rocked by the emerging COVID-19 pandemic during 2020. The virus and associated mitigation measures resulted in some delayed or scaled-back projects, and a few exploration projects were cancelled entirely. Travel restrictions and quarantine policies added significant expense for companies, not to mention the burden placed on the industry workforce and families as miners endured hotel quarantines of up to 14 days prior to lengthened on-site rotations. Some operations reported diminished productivity, but whole-year production remained within normal ranges. The effects of the pandemic on the global economy hurt base metal prices and mine revenues, but precious metals producers felt the opposite effect as prices for gold and silver escalated dramatically; altogether, Alaska revenue to industry climbed ten percent. Exploration expenditures fell 15 percent to $145.9 million, but Alaska's combined gold exploration budget jumped 45 percent to $100 million. Overall, the value of Alaska's mining industry rose five percent to an estimated $3.2 billion.

Overall, the value of Alaska's mining industry rose five percent to an estimated $3.2 billion

The exploration, development, and production values used in this report are compiled from past-year statements issued by companies, including press releases and corporate annual and financial reports, as well as phone interviews, replies to questionnaires, and news media articles. Average metal prices used in the first-market-value calculations that are incorporated into estimated mining revenues and commodity values are based on average daily prices on the London Metal Exchange. Coal prices are estimated from Alaska energy sector prices and available coal heating values. Industrial materials prices are based on regional rates reported by operators. Many of the numbers contained in this report are estimates: commodity values and company revenue estimated from theoretical first market values are likely to be overstated, while numbers based on voluntary reporting are likely to be minimum estimates of the value of the mining industry to Alaska's economy.

This report is a cooperative project led by the Alaska Division of Geological & Geophysical Surveys (DGGS) in the Department of Natural Resources (DNR), with support from the DNR Division of Mining, Land & Water (DMLW), the Department of Labor and Workforce Development (DLWD), and the Department of Revenue (DOR). The agencies involved in producing this report are committed to producing a reliable annual commentary on mineral industry activity in Alaska, which is vital for informed decision-making by State and local governments, the Legislature, land managers, industry, Native corporations, and the public.

Table 1. Reported annual exploration and development expenditures of the mineral industry, the estimated theoretical first market value of mineral production in Alaska, and estimated revenue to the mineral industry from the sale of those commodities (in millions of dollars), 1981–2020. Average annual values are given for 1981–1985, 1986–1990, 1991–1995, and 1996–2000; individual year totals are provided for 2001–2020.

Year	Exploration Expenditures ($ millions)	Development Expenditures ($ millions)	Theoretical First Market Value ($ millions)[a]	Estimated Revenue to Industry ($ millions)[b]
1981–1985	$37.5	$36.3	$204.7	–
1986–1990	$36.2	$109.6	$288.6	–
1991–1995	$33.2	$55.3	$520.1	–
1996–2000	$49.4	$158.7	$917.4	–
2001	$23.8	$81.2	$917.3	–
2002	$26.5	$34.0	$1,012.8	–
2003	$27.6	$39.1	$1,000.7	–
2004	$70.8	$209.1	$1,338.7	–
2005	$103.9	$347.9	$1,401.6	–
2006	$178.9	$495.7	$2,858.2	–
2007	$329.1	$318.8	$3,367.0	–
2008	$347.3	$396.2	$2,427.1	–
2009	$180.0	$330.8	$2,455.6	–
2010	$264.4	$293.3	$3,126.8	–
2011	$365.1	$271.9[c]	$3,507.7	–
2012	$335.1	$342.4	$3,436.1	–
2013	$175.5	$358.8	$3,418.7	–
2014	$96.2	$281.7	$3,282.1	–
2015	$58.3	$309.9[c]	$2,759.2	–
2016	$58.9	$217.4	–	$2,536.6
2017	$120.8	$299.5	–	$2,724.7
2018	$140.1	$334.1	–	$2,428.1
2019	$171.0	$347.8	–	$2,530.0
2020	$145.9	$267.8	–	$2,790.9

Exploration, development, and production figures are provided in Alaska's Mineral Industry reports published annually by DGGS and sister agencies.

[a]Theoretical first market value is calculated by multiplying reported commodity amounts produced for a calendar year by the average yearly price per unit. This figure may significantly overestimate the value of the commodity, because it assumes that the commodity is a pure, final product and the operator has incurred no addtional charges during its production.

[b]Estimated revenue to industry is compiled from 1) revenue figures reported for the calendar year by major mine operators (accounting for actual sale prices and including smelting and refining charges and transportation costs), except a theoretical first market value is substituted when actual mine revenue is unavailable; 2) calculated value of industrial materials (rock, sand, and gravel) produced from some State and Federals lands (table 10); and estimated gross operating income of placer mining operations from Mining License Tax forms as reported by the Department of Revenue (table 11).

[c]2011 and 2015 total missing significant expected data

– = Not reported

EMPLOYMENT

Total mineral industry employment in 2020 is estimated at 3,225 full-time-equivalent jobs, an overall decrease of about 261 jobs or eight percent from 2019 (table 2). The exploration sector lost an estimated 16 jobs, down five percent from 2019. Exploration employment was estimated for 27 of 57 lode exploration projects using their reported exploration expenditure in conjunction with cost-per-project ratios averaged from 33 projects with complete employment data.

Mine development activities lost 128 jobs, while mine production lost 118, a combined loss of 245 positions (8 percent). Changes in the number of development jobs is likely tied to the cycle of specific large capital projects at Alaska's mines. Note that most large operators do not differentiate production from development employment: since 2014, development and production employment, when not specifically provided by the operator, have been estimated for large operations based on their reported ratio of production to development expenditures.

Placer employment continued a downward trend, and it is estimated that more than

Table 2. Estimated Alaska mineral industry employment, 2009–2020[a], as compiled from public documents, MSHA reporting[b], personal communications, and other sources. The total employment number for an operation may be divided among exploration, development, and production activites based on the reported expenditures in those categories.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Gold/silver mining												
Placer[c]	399	405	439	477	432	241	224	222	193	192	159	141
Lode	832	1,008	1,085	1,206	1,176	1,054	1,047	1,253	1,193	1,132	1,174	1,002
Polymetallic mining	321	350	364	386	390	287	303	306	324	316	342	326
Base metals mining	413	550	586	530	550	446	475	526	606	482	502	659
Recreational mining	36	35	41	52	55	7	–	–	–	–	–	–
Industrial minerals							173	253	197	237	272	198
Sand and gravel	286	313	307	424	565	30	–	–	–	–	–	–
Rock	83	11	28	60	19	65	–	–	–	–	–	–
Coal[d]	117	140	140	144	120	115	112	100	89	99	96	102
Peat[d,e]	–	3	3	4	–	<1	–	–	–	–	–	–
Tin, jade, soapstone, ceramics, platinum	–	–	–	–	1	1	–	–	–	–	–	–
Production (total of above categories)	2,487	2,815	2,993	3,283	3,308	2,246	2,230	2,660	2,602	2,458	2,545	2,427
Mineral development	371	537	422	535	358	468	555	412	536	638	622	494
Mineral exploration	422	520	535[f]	548	385	253	116	160	254	373	319	303
Total	**3,280**	**3,872**	**3,950**	**4,366**	**4,051**	**2,967**	**2,901**	**3,232**	**3,392**	**3,469**	**3,486**	**3,225**

[a]Reported person-days are calculated on a 260-day work year and 10-hour work day to obtain average annual employment unless actual average annual employment numbers are provided.

[b]MSHA data: arlweb.msha.gov/OpenGovernmentData/DataSets/MinesProdYearly.zip

[c]See table 11 for updated information on placer employment calculations.

[d]Coal and peat employment numbers are combined in 2009.

[e]This figure does not include all of the person-days associated with peat operations; most of those person-days are included in sand and gravel numbers.

[f]Average of 520–550 range reported for 2011.

– = Not reported

See Exploration, Development, and Production sections for further details.

two-thirds of placer work (calculated as full-time equivalents) has been lost since the 2012 high. Estimated placer employment fell by 11 percent or 18 jobs between 2018 and 2019. Placer mining statistics are collected by DOR and are shifted back a year to align the data more closely with the year of production, instead of the year in which the data were reported to DOR from operators. Placer mining employment in 2019, and projected to 2020, was estimated from the number of placer mines that reported gross operating income on Mining License Tax returns: a methodology fully explained in table 11. Placer mine employment is challenging to quantify due to the large number of small or seasonal operations, sole-proprietors, and family-based businesses.

Mine Safety and Health Administration (MSHA) data indicate that industrial materials production (rock, sand, and gravel) full-time-equivalent employment fell by 27 percent (74 jobs).[3] This trend is in line with reported material-sale volumes from public land, which decreased by 39 percent in 2020 (table 12). While materials-sector employment (and production volumes and values) are underreported, the MSHA dataset captures its employment more completely than past voluntary reporting through questionnaires.

This report relies on a variety of sources to tabulate mineral industry employment, including publicly available company documents, personal communications, and questionnaires sent out by DGGS. Many exploration companies and mine operators voluntarily responded to questionnaires with 2020 employment information. Affidavits of Annual Labor also provided 2020 employment data for hard-rock exploration projects. Additional employment information was obtained from MSHA. These datasets and sources represent a minimum estimate and an incomplete picture of mineral industry employment in Alaska, but the values that are available add to the statewide mining employment total and provide a more complete estimate of the impact of mining to the State's workforce and wealth-generation potential. Except for placer employment, full-time-equivalent positions are based on a 260-day work year and 10-hour workday unless actual average annual employment numbers are provided.

The Alaska Department of Labor and Workforce Development (DLWD) provided 2020 mining employment and wage statistics based on 121 reporting units (companies) consisting of 50 metal ore, 36 coal and nonmetallic-mineral quarrying, and 35 mining-support-activity units. Among companies in 2020, mining and support activities provided 3,250 jobs, up slightly from 3,242 jobs in 2019. Metal ore and coal and nonmetallic-mineral quarrying units gained employees, while employees carrying out support activities decreased by 65 percent. DLWD data show that nonmetallic-mineral-product manufacturing provided 232 jobs, which includes an average of 213 jobs in cement and concrete manufacturing for 2020. Primary metal manufacturing provided 14 jobs, while metal and mineral merchant wholesalers provided an average of 121 jobs during 2020.

According to DLWD data, 18 boroughs or census areas reported mining (excluding oil and gas) employment in 2020. Juneau, Anchorage, and Fairbanks area (combined Fairbanks North Star Borough and Southeast Fairbanks Census Area) accounted for more than 70 percent of mining employment in the State. In 2020, the Fairbanks area gained two new mining-related businesses, employed 138 additional workers, and had the highest number of mining jobs (1,357) among Alaska boroughs or census areas. The City and Borough of Juneau came in second with 804 jobs, down almost seven percent from 863 jobs in 2019.

Wages for mining-sector jobs, averaging $117,913 in 2020, were some of the highest among major industries in Alaska. The average mining-sector wage grew almost seven percent

[3]Mine Safety and Health Administration, Employment/Production Data Set (dataset 9); last accessed September 20, 2021; arlweb.msha.gov/OpenGovernmentData/OGIMSHA.asp

from $110,450 in 2019, while the average private-sector wage ($60,552) grew almost eight percent, slightly narrowing the huge disparity between these wages. Total wages paid by non-oil-and-gas mining firms in 2019 were $366,826,726, up more than ten percent from 2019. All non-oil-and-gas mining firms showed growth in total annual wages in 2020 except for those of mining-support firms ($16,702,125), which decreased almost 30 percent from 2019.

DLWD employment data are based on wage records, and include part-time jobs but do not include the self-employed and working family members not covered under unemployment insurance. The majority of placer operators are self-employed and are therefore not counted in the DLWD data. Employment data may not include jobs in the exploration and development phases of mining at geological and engineering consulting firms that are categorized in the engineering, environmental, or construction industries. Consequently, mining's contributions to employment and earnings in Alaska are likely understated by DLWD's dataset.[4]

An in-depth report on the economic impact of the mining industry in Alaska, prepared by the Alaska Miners Association (AMA) in consultation with the McKinley Research Group, estimates that in 2020 Alaska's mining industry provided 4,700 direct mining jobs and an additional 4,900 indirect jobs. Direct and indirect wages totaled an estimated $890 million. The AMA report uses surveys and other research and analysis methods in an effort to include mining industry employment not captured by the DLWD and DGGS datasets. Mining employees live in more than 90 communities throughout Alaska.[5]

[4]State of Alaska Department of Labor and Workforce Development (DLWD), Research and Analysis Section, Quarterly Census of Employment and Wages (QCEW); last accessed September 21, 2021; live.laborstats.alaska.gov/sites/default/files/2021-08/Annual%20January%20to%20December%202020.pdf

[5]Alaska Miners Association, The Economic Benefits of Alaska's Mining Industry, February 2021; last accessed September 21, 2021; 5852be2f-63c0-42f3-8c04-dd902d965ff8.filesusr.com/ugd/beae26_9cfea936ffdf45b89115a89bfcc9a227.pdf

GOVERNMENT REVENUES FROM ALASKA'S MINERAL INDUSTRY

In 2020 government revenue from Alaska's mineral industry totaled $119.1 million (table 3). The 17 percent decrease from $143.7 million in 2019 is due to declines in State Corporate Income Tax and Mining License tax receipts, which are reported for the State fiscal year (FY 2020: July 1, 2019–June 30, 2020). Table 3 provides an itemized listing of estimated revenues paid to the State and municipalities. These revenues are incomplete and serve only as a minimum. New to table 3 are receipts from Alaska Railroad Corporation commodities shipping related to mineral industry activities. Additionally, DNR reported that $146,547 were received in bond pool payments in 2020. Bond pool payments, which are reclamation financial assurance and not considered State revenue, may only be used to reclaim sites disturbed by mining activities.

State Corporate Income Tax (CIT) collections in FY 2020 declined steeply, with refunds exceeding payments by $7.7 million dollars. This continues the trend of extreme variability in this State revenue stream. FY 2020 CIT receipts are impacted by negative cashflow operations at one or more mines that occurred prior to the escalation of the gold price in mid-2020.

Operators and royalty payees reported total gross income of $2.38 billion for mineral commodities that sold in tax year (TY) 2019 (December 1, 2018–November 30, 2019; table 4); this income is compiled from the Mining License Tax returns filed in TY 2020 and is the most recent figure available at the time of this report. Total gross income from mining activity that occurred in TY 2020 will be reported in a future edition of this report. Total gross income from TY 2019 differs from the 2019 'estimated revenue to industry' of $2.8 billion in table 1, because the latter is compiled for the calendar year and includes some theoretical first market values of mineral production that may not have been sold during that time period, as well as the value of untaxed sand and gravel products. Table 4 includes royalty-only taxpayers: royalty-only taxpayers are typically landowners who receive revenue solely from a royalty share with no gross income from mining operations. All major mines in Alaska earn gross income from mining operations and their income is included in the table's values. Income from Alaska's new Dawson mine is included in the table for the 2019 tax year.

Mining License Tax collections fell significantly in 2020, declining 27 percent to $35.0 million as zinc and lead prices continued to slump (table 3). The Mining License Tax, unlike the Corporate Income Tax, does not have loss carryforward or carryback provisions, and therefore follows metal prices more closely. DOR reported that 355 taxpayers submitted Mining License Tax returns in TY 2020 for production in the 2019 tax year, of which 40 (11 percent) were liable for taxes on net taxable income from mining in the amount of $383.8 million, a 26 percent decrease from TY 2018 net taxable income (table 4). Negative net taxable incomes from mining, at an average loss of $1,026,544 per taxpayer, were reported by 117 taxpayers.

Revenue to municipalities rose in 2020 to $50.6 million, a 22 percent increase over 2019. In Juneau, Fairbanks, and the Northwest Arctic Borough, revenue from mining-related activity was among the largest contributors to municipal and borough budgets. In addition, the mining industry paid almost $2.0 million to Native corporations, and Alaska communities received more than $1.6 million in charitable donations from the mining industry.

AMA's report on mining lists other benefits to the State.[5] In 2020, the Alaska Railroad Corporation received approximately $15.2 million from transportation of coal, sand, and gravel. AMA estimates that Alaska's mining industry purchased about $880 million in goods and services from about 600 Alaska vendors in support of operations.

Table 3. Reported and estimated revenues paid to the State of Alaska and municipalities by Alaska's mineral industry, 2015–2020. The figures in this table will change as data are reviewed and updated; the table has been significantly updated to reflect Department of Natural Resources and Department of Revenue reporting for previous years. See footnotes for reporting sources and dates.

		2015	2016	2017	2018	2019	2020
State mineral rents and royalties[a,b]							
State claim rentals		6,920,029	7,327,630	7,658,003	7,192,888	9,104,615	9,253,677
Production royalties[c]		4,608,137	2,816,884	3,125,925	2,472,558	797,152	169,482
Annual labor		321,419	331,986	374,244	392,085	438,098	331,210
Subtotal	**$**	**11,849,585**	**10,476,500**	**11,158,173**	**10,057,531**	**10,339,865**	**9,754,369**
State coal rents and royalties[b]							
Rents		351,724	347,324	268,866	231,159	223,799	415,454
Royalties[c]		2,430,267	2,237,777	2,232,394	1,971,999	2,519,086	2,375,927
Bonus		111,000	–	–	100	-100	–
Subtotal	**$**	**2,892,992**	**2,585,101**	**2,501,260**	**2,203,258**	**2,742,785**	**2,791,381**
State material sales[b]							
Mental Health		69,163	25,130	24,366	50,558	15,144	2,700
Division of Land		11,293,545	6,412,271	4,637,844	4,540,134	6,734,784	2,831,123
State Pipeline Coordinator's Office		197,644	121,994	288,511	93,359	47,327	916,856
Subtotal	**$**	**11,560,352**	**6,559,395**	**4,950,720**	**4,684,051**	**6,797,255**	**3,750,679**
State mining miscellaneous fees[b]							
Filing fees		2,100	9,650	4,825	5,150	4,200	105,960
Bid Bonus		–	193,963	–	–	–	205,506
Penalty fees		43,307	95,677	220,770	91,920	135,611	40,089
Exploration incentive app filing fee		–	–	–	–	–	–
Surface mine investment interest		7,801	19,690	–	–	–	193,448
Surface coal mining app fee		21,700	7,218	8,000	7,342	-653	–
APMA mining fees		24,302	21,627	21,302	29,024	66,171	–
Subtotal	**$**	**99,210**	**347,826**	**254,897**	**133,436**	**205,329**	**545,002**
Other Fees							
AIDEA - Facilities use fees[d]		11,356,000	10,709,000	10,014,951	9,081,619	8,129,483	6,975,615
State Fuel Taxes[e]		Not reported	2,066,313	1,338,843	1,411,896	1,015,005	1,005,467
State corporate income tax[f]		17,320,051	1,636,850	-734,744	34,594,928	6,859,747	-7,733,308
Mining License Tax[g]		38,655,209	11,131,203	41,525,192	47,297,409	47,777,544	35,043,196
Large Mine Permit Coordination Program Receipts[h]		1,725,021	1,364,952	968,827	928,035	991,271	1,193,278
Alaska Railroad receipts[i]		–	17,500,000	21,200,000	15,900,000	17,400,000	15,200,000
State Total	**$**	**95,468,420**	**64,377,140**	**93,178,119**	**126,292,163**	**102,258,284**	**68,525,679**
Payments to Municipalities[j]		21,041,152	22,656,383	48,628,626	34,282,140	41,481,284	50,555,237
Total	**$**	**116,509,572**	**87,033,523**	**141,806,745**	**160,574,303**	**143,739,568**	**119,080,916**

[a] Includes upland lease and offshore lease rentals. Figures are reported by calendar year by the Alaska Department of Natural Resources.

[b] Figures are reported by calendar year by the Alaska Department of Natural Resources.

[c] Reported on a cash basis; payments actually received during the given year.

[d] AIDEA user fees for use of the State-owned roads and ports: the De Long Mountain Transportation System by Teck Alaska Inc., operator of the Red Dog mine; and for use of the Skagway Ore Terminal by Minto Explorations Ltd., a subsidiary of Pembridge Resources. AIDEA figures are reported by fiscal year.

[e] Values from 2016–2020 were reported by the major operating mines, less their fuel tax refund.

[f] Only subchapter C corporations pay income tax. This report may not reflect 100% of the returns received in a year. The amount of corporate income tax reported in each fiscal year is the amount of tax actually received and may not agree with the amount reported on a corporation's tax return. This is due primarily to timing differences.

[g] In 2012 and later, Mining License Tax was not collected on materials. Figures are reported by fiscal year. http://tax.alaska.gov/programs/programs/reports/AnnualData.aspx?60610

[h] The DNR, Office of Project Management and Permitting (OPMP) recovers costs from applicants for large mine permit coordination, per AS 38.05.020(b)(9) and AS 37.05.146(b)(3). Figures are reported by fiscal year.

[i] Alaska Railroad revenue for transportation of coal, sand, and gravel. From "The Economic Impact of Alaska's Mining Industry" published by the Alaska Miners Association, February 2021.

[j] Payments to Municipalities include property taxes, payments in lieu of taxes (PILT), and severance taxes. Data should be considered a minimum estimate. Data were primarily provided by the major operating mines.

Table 4. Mining tax analysis by tax bracket for the 2017–2019 tax years, based on Mining License Tax returns. Analysis includes income from operations plus royalty income, including both royalty-only tax payers and those with both income from operations and royalty income. Information provided by the Alaska Department of Revenue. The figures in this table will change as data are reviewed and updated. Note yearly values reported by the Department of Revenue are adjusted to align with the production year.

Bracket	Marginal tax rate	No. of taxpayers	Total gross income	Net taxable income*	Net income as percentage of gross	Total tax liability	Average gross income	Average taxable income	Average tax liability
Tax Year 2017									
Under $0	0%	145	$170,883,000	$ -43,820,418	-26%	$0	$1,178,503	-$302,210	$0
$0 to $40,000	0%	246	$9,473,810	$1,207,899	13%	$0	$38,511	$4,910	$0
$40,001 to $50,000	3%	12	$1,394,394	$500,799	36%	$15,024	$116,199	$41,733	$1,252
$50,001 to $100,000	5%	20	$5,226,727	$1,351,991	26%	$47,600	$261,336	$67,600	$2,380
Over $100,000	7%	20	$3,243,156,732	$935,472,556	29%	$64,952,745	$162,157,837	$46,773,628	$3,247,637
Total		**443**	**$3,430,134,663**	**$894,712,827**		**$65,015,369**			
Tax Year 2018									
Under $0	0%	135	$678,343,577	$ -68,594,263	-10%	$0	$5,024,767	-$508,106	$0
$0 to $40,000	0%	226	$7,355,921	$1,077,409	15%	$0	$32,548	$4,767	$0
$40,001 to $50,000	3%	10	$494,845	$414,741	84%	$12,442	$49,484	$41,474	$1,244
$50,001 to $100,000	5%	14	$3,771,833	$991,149	26%	$35,557	$269,417	$70,796	$2,540
Over $100,000	7%	18	$1,677,817,899	$514,427,874	31%	$35,627,720	$93,212,105	$28,579,326	$1,979,318
Total		**403**	**$2,367,784,075**	**$448,316,910**		**$35,675,719**			
Tax Year 2019									
Under $0	0%	117	$747,952,070	$ -120,105,699	-16%	$0	$6,392,753	-$1,026,544	$0
$0 to $40,000	0%	198	$7,631,662	$1,153,197	15%	$0	$38,544	$5,824	$0
$40,001 to $50,000	3%	14	$1,604,884	$614,158	38%	$18,425	$114,635	$43,868	$1,316
$50,001 to $100,000	5%	9	$2,853,887	$658,780	23%	$23,939	$317,099	$73,198	$2,660
Over $100,000	7%	17	$1,624,155,417	$382,491,765	24%	$26,466,580	$95,538,554	$22,499,516	$1,556,858
Total		**355**	**$2,384,197,920**	**$264,812,201**		**$26,508,944**			

*Net income taxable under the Mining License Tax

Note: Taxpayers with negative income (under $0) are not a separate bracket, but are reported separately to distinguish between large money-losing operations and small operations with zero or positive income.

See page 7 for the differences between Total Gross Income (table 4) and the Estimated Revenue to Industry (table 1).

MINERALS-RELATED GOVERNMENT ACTIVITIES

U.S. Geological Survey

The U.S. Geological Survey (USGS) Mineral Resources Program had multiple projects focused on the geologic framework and mineral resources of Alaska in 2020. Alaska Science Center research staff in Anchorage conducted field-based studies of the tectonic and metallogenic evolution of the Yukon–Tanana uplands, eastern Alaska, and on the geology and mineral resource potential of mafic and ultramafic rocks in interior Alaska. All other field research was canceled or postponed by the COVID-19 pandemic.

Research staff at the Geology, Geophysics, and Geochemistry Science Center (G3) in Denver published the results of an exploration geochemistry study near the Taurus porphyry copper deposit in eastern interior Alaska (Kelley and Graham, 2021, doi.org/10.1016/j.apgeochem.2020.104821). Accompanying data were published as a USGS data release (Kelley and others, 2020, doi.org/10.5066/P94KBWD3). The purpose of the study was to identify potential indicator minerals in stream sediments and assess the utility of indicator minerals and hydrogeochemistry in this part of Alaska. Ongoing work extends these exploration methods in the area containing the Pogo deposit in the Goodpaster Mining District. Research staff from Denver also continued to conduct studies on gold vein samples from Pogo and the Black Mountain district placer, together with gold provenance studies in the Fortymile and Fairbanks mining districts involving characterization of populations of gold particles according to both alloy compositions and suites of mineral inclusions (microchemical characterization).

Following the successful GIS-based evaluation of critical mineral potential in Alaska in 2016, research staff in Anchorage and Denver mapped the potential for lode gold associated with porphyry, reduced intrusion-related, epithermal, and orogenic deposits (Karl and others, 2021, doi.org/10.3133/ofr20211041). Another similar report was completed for sediment-hosted Pb–Zn deposits in Alaska (Kelley and others, 2021, doi.org/10.3133/ofr20201147). Additional geochemical and geophysical datasets were added to the analysis to help reduce uncertainty in the evaluation rankings. Work continued on improving and adapting the evaluation method for sediment-hosted copper, volcanogenic massive sulfide (VMS), and porphyry copper deposits. A topical study of the Graphite Creek deposit, Seward Peninsula, was commenced to develop a geological model and salient criteria to be used for GIS analysis of regional flake graphite potential. Also, a USGS three-part mineral resource assessment was completed for tungsten skarn deposits in the Yukon–Tanana uplands. A quantitative assessment was conducted in the vicinity of Fairbanks, and a qualitative assessment was done for the rest of the uplands.

Finally, research staff from Anchorage and Denver participated in national science planning for the USGS Earth Mapping Resource Initiative (Earth MRI) and developed multiple Alaska focus areas that have critical mineral potential and require new geological mapping and geophysical data acquisition. A USGS Open File Report presenting Alaska focus areas that have potential for antimony, barite, beryllium, chromium, fluorspar, hafnium, magnesium, manganese, uranium, vanadium, and zirconium will be published in 2021.

U.S. Bureau of Land Management

The U.S. Bureau of Land Management (BLM)–Alaska administers and adjudicates all Federal mining claim locations in Alaska, manages mining and other activities on BLM-managed lands, and continues its mission to convey land to the State of Alaska as well as Alaska Native village and regional corporations.

Annually, the BLM conveys thousands of acres of land to the State and Native corporations under the authority of the Alaska Statehood Act and the Alaska Native Claims Settlement Act (ANCSA).

Related to land management, BLM continued research, identification, inventory, and inspection of closed Federal mining claims in anticipation of conveying those lands to the State of Alaska as the subject lands become available for selection and conveyance.

In 2020, BLM implemented policies to maintain continuity of operations as the SARS2 COVID-19 virus pandemic developed. It allowed BLM mining staff to continue to safely conduct their inspections and regulatory responsibilities.

Also in 2020, BLM published a draft Resource Management Plan (RMP) and Environmental Impact Statement for the Central Yukon planning area. The publication was accompanied by a public comment period and development of the final RMP continues. In July 2020, BLM also published the Record of Decision for an industrial road, proposed by the Alaska Industrial Development and Export Authority (AIDEA), to the Ambler Mining District.

To improve RMPs and other future land use planning efforts, a cooperative agreement between BLM Alaska and DGGS was amended to expand geophysical surveys between the Fortymile River and Eagle, Alaska. Results are expected to be published in 2021.

Division of Mining, Land and Water

The Division of Mining, Land and Water (DMLW) manages mineral exploration and development on more than 96 million acres of State land in Alaska. In addition, the Division reviews and approves the operation and reclamation plans for mining projects, including coal, on all State, Federal, and private lands in Alaska. In 2020, the Division's Large Mine Permitting Team coordinated hard rock mine permitting activities at Red Dog, Fort Knox, Pogo, Kensington, Greens Creek, Nixon Fork, and Manh Choh (Tetlin).

Advanced exploration projects active in 2020 include, but are not limited to, Donlin Gold in Southwest Alaska, Pebble project near Iliamna, Graphite Creek project on the Seward Peninsula, Palmer project near Haines, Livengood Gold project in the Tolovana Mining District, and Upper Kobuk Mineral Projects at Arctic and Bornite. Regional exploration efforts in the Goodpaster Mining District near Pogo mine and the western Alaska Range also ramped up in 2020. DMLW manages mineral exploration and placer mining through the Application for Permits to Mine in Alaska (APMA). In 2020 there were 552 operations with active APMAs. Of these operations, 393 were for placer mining and exploration, 73 were for hard rock exploration, and 86 were for suction dredging activities.

The State regulates coal mining through the Coal Mining Regulatory program. In addition to inspection and permitting of ongoing mining and reclamation at the Usibelli Coal Mine operations in Healy and inspection of inactive operations in the Wishbone Hill area, 2020 saw continued interest in coal exploration in the Canyon Creek area south of Skwentna.

The State Abandoned Mine Lands Program (AML) for the past seven years has been actively reclaiming legacy coal mines that were left abandoned in the Healy Valley. Most recently the program completed the Vitro pit, which eliminated 2,200 feet of highwall that in places exceeded 140 vertical feet. The project took three years to complete, regrading 700,000 cubic yards of material at a cost of nearly $5.1 million. AML is now focused on reclaiming the Cripple Creek pit, which will be accomplished in two separate phases. Phase I began in August of 2020 and is slated to be completed in the early summer of 2022. Phase II will begin as early as 2022. The AML program will remain active in the Healy Valley for at least the next ten years.

Division of Geological & Geophysical Surveys

Alaska Geologic Materials Center

The Alaska Geologic Materials Center (GMC), curated and operated by DGGS, is the State's largest and most comprehensive archive of geologic samples. The GMC houses drill core from numerous Alaska mineral prospects, DGGS rock samples, and the Alaska collections of the U.S. Geological Survey, the former U.S. Bureau of Mines, and other agencies.

Sample donations to the 100,000-square-foot facility at 3651 Penland Parkway in Anchorage have pushed the total collections to nearly three-quarters full. The new facility features comfortable viewing areas with roller tables and high-lumen overhead lighting. The sample preparation room contains 10," 14," and 20" rock saws. The GMC tracks more than 750,000 samples, including 38,806 mineral core boxes from 277 prospects representing 2,263 boreholes. The browser-based search interface (maps.dggs.alaska.gov/gmc) allows users to build simple to complex queries through text- or map-based searches to find samples of interest. Significant donations in 2020 included exploration records from WGM (Riz Bigelow) and Union Bay rescue core from Free Gold Recovery USA (Avalon; photo 2).

Photo 2. Rescued drill core awaits re-boxing at the DGGS Geologic Materials Center in Anchorage. Photo courtesy of Kurt Johnson, DGGS.

Mineral Resources Section Activities

The DGGS Mineral Resources Section uses its expertise in mineral deposit geology, geophysics, and geochemistry to evaluate State land for its potential to host undiscovered mineral resources (table 5). Section staff conduct geophysical surveys, geologic mapping, mineral-resource assessments, and ore deposit research; they also track mineral industry exploration and discoveries, development, and production. Additionally, the Section's expertise and knowledge are utilized to review other Departmental actions, including State land selection conveyance prioritization, land-use plans, land disposal actions, review of Federal actions, and infrastructure planning. The geophysical, geological, and resource surveys conducted by the Mineral Resources Section not only inventory the potential for mineral resources but add value to the State's current and future revenue.

Since 1993 the data products of the Airborne Geophysical/Geological Mineral Inventory (AGGMI) program have been an important component of successful resource-exploration programs; products have contributed to the private-sector discovery of more than 22 million ounces of gold resources in the Salcha River–Pogo and Livengood areas (fig. 2). State budget cuts impacted the AGGMI program, resulting in the loss of a permanent staff position in the Mineral Resources Section and decreases in its annual funding for data collection and publication. New geophysical surveys now rely on funding from external sources or the State of Alaska capital budget.

Table 5. New mineral resource-related DGGS publications in 2020.

Geologic maps, reports, and geochemical data
Alaska's mineral industry 2019 (report) – doi.org/10.14509/30658
Alaska's mineral industry in 2019 (presentation) – doi.org/10.14509/30427
Northeast Tanacross project U-Pb geochronology – doi.org/10.14509/30465
Northeast Tanacross project Ar/Ar geochronology – doi.org/10.14509/30466
Wrangellia Ni-Cu-PGE project report – doi.org/10.14509/30468
Wrangellia Ni-Cu-PGE project geologic map – doi.org/10.14509/30469
Richardson project Ar/Ar geochronology data – doi.org/10.14509/30530
Tok River project economic geology report – doi.org/10.14509/30471
Tok River project U-Pb geochronology – doi.org/10.14509/30439
Eastern Tanacross project field data – doi.org/10.14509/30268
Eastern Tanacross project draft geologic map (poster) – doi.org/10.14509/30429
Mount Fairplay petrology and economic geology report – doi.org/10.14509/30463
Information circular: Understanding radon test results – doi.org/10.14509/30467
Information circular: Mitigating radon levels at home – doi.org/10.14509/30474
Geophysical surveys
Shaw Creek—Shawnee Peak magnetic-radiometric survey – doi.org/10.14509/30551
Goldstream Valley gravity survey – doi.org/10.14509/30473
Pilgrim Hot Springs CSAMT survey – doi.org/10.14509/30472
Geophysical surveys re-released in modern digital formats
Alaska Highway corridor – doi.org/10.14509/30462
Bethel basin – doi.org/10.14509/30458
Broad Pass – doi.org/10.14509/30415
Chulitna – doi.org/10.14509/30416
Dolomi – doi.org/10.14509/30431
East Styx – doi.org/10.14509/30412
Headwaters of the Little Chena River – doi.org/10.14509/30418
Hetta – doi.org/10.14509/30433
Holitna basin – doi.org/10.14509/30459
Kasaan – doi.org/10.14509/30432
Ketchikan – doi.org/10.14509/30430
Koyukuk – doi.org/10.14509/30434
Ladue – doi.org/10.14509/30261
Lower Yukon Delta – doi.org/10.14509/30460
Nikolai – doi.org/10.14509/30262
Rampart-Manley – doi.org/10.14509/30417
Richardson – doi.org/10.14509/30263
Ruby – doi.org/10.14509/30265
Southern NPRA – doi.org/10.14509/30441
Stikine – doi.org/10.14509/30457

Geophysical Datasets

In the summer of 2020, DGGS collected and published the Shaw Creek and Shawnee Peak airborne magnetic and radiometric survey. These data can be found online at dggs.alaska.gov/geophysics/get-data.html. This helicopter-based survey was funded by the State of Alaska, Northern Star Resources, Millrock Exploration, and Kenorland Minerals. More than 50 percent of the funding came from industry partners. The State-funded portions were flown at 400-meter line spacing, while the industry blocks were flown at 100- and 200-meter line spacings. All collected data are available to the public. To benefit our industry partners, preliminary data was released 12 days after data collection was completed.

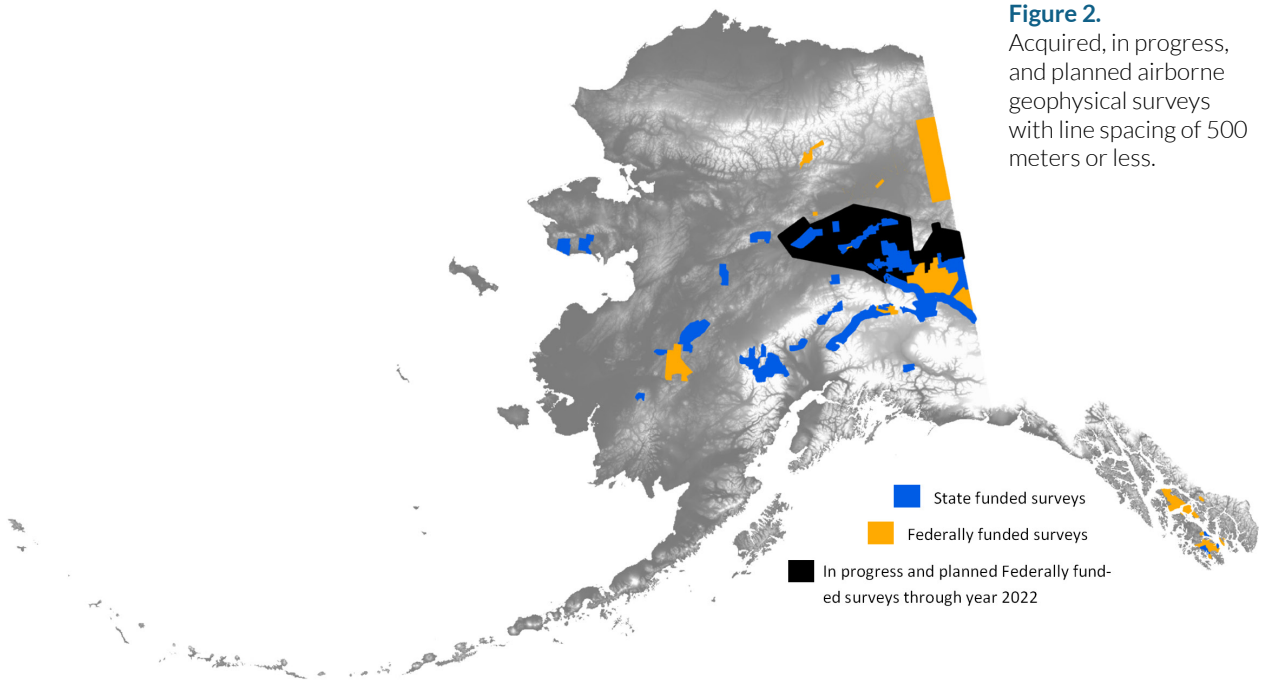


Figure 2. Acquired, in progress, and planned airborne geophysical surveys with line spacing of 500 meters or less.

In 2020 DGGS received $500,000 of USGS Earth MRI and $175,000 of BLM funding to acquire fixed-wing magnetic and radiometric data in the Yukon–Tanana uplands. These data were collected in summer 2021. The Federal Fiscal Year 2019 Earth MRI-funded, fixed-wing magnetic and radiometric survey is delayed until 2022. DGGS anticipates achieving complete magnetic data coverage of the Yukon–Tanana uplands by fall of 2022. DGGS' complete collection of "modern" airborne magnetic, electromagnetic, and radiometric geophysical data are available for download through the DGGS website.

Geologic Mapping and Geochemical Sampling

The DGGS Mineral Resources Section planned to complete a 1,730 mi^2 geologic map of the western Tanacross Quadrangle in 2020, but the project was delayed due to the emerging COVID-19 pandemic. The project was funded by the USGS' newly created Earth MRI, which funds new geologic mapping of areas that are prospective for discovery of strategic and critical minerals (photo 3).

The Mineral Resources Section published a bedrock geologic map and accompanying report on the Wrangellia terrane in the Talkeetna Mountains and eastern Alaska Range, an area of ongoing exploration for nickel, copper, cobalt, and platinum group elements. Other economic-geology themed reports covered the gold and massive-sulfide mineral occurrences of the Tok River area, and the petrology and rare earth element potential of the Mount Fairplay region. Other reports included geochemical and geochronological data releases tied to ongoing mapping projects (table 5).

Photo 3. DGGS Mineral Resources Section geologist Alicja Wypych starts a mapping traverse in eastern interior Alaska. Photo courtesy of Sean Regan, University of Alaska Fairbanks.

Curtis J. Freeman, a long-time member of the Alaska Minerals community, retired in 2020. Curt has contributed greatly to mineral exploration in Alaska, especially to the recognition and discovery of lode gold deposits across interior Alaska.

Curt served as the Chairman of the Geologic Mapping Advisory Board at the State of Alaska, Division of Geological & Geophysical Surveys (DGGS). In this capacity, he helped guide DGGS work in areas important to Alaska's mineral explorers. Curt also provided valuable information over the years that was crucial to the data presented in the Alaska Minerals Industry Reports. His counsel was greatly appreciated by the reports' authors.

Curt founded Avalon Development Corp. in 1985 and served as the company president. Curt and his team at Avalon are credited with numerous gold, silver, copper, nickel, platinum group, and rare metal discoveries in Alaska and worked in the Yukon, the western United States, Central America, South America, New Zealand, and Africa. Avalon closed its doors on February 29, 2020, a fitting day to end a highly successful company with numerous major and junior mining companies as past clients.

Curt provided valuable summaries of Alaska's mineral industry beyond the information he shared with DGGS. In the late 1990's, Curt began writing quarterly Alaska mining news summaries for the Society of Economic Geologists (SEG) newsletter. That work soon included writing monthly summaries for the Mining News Alaska publication. Most recently, he was a frequent contributor to North of 60 Mining News and Alaska Business magazines, with monthly, quarterly and annual Alaska mining news summaries.

Curt has resided full time in Fairbanks, Alaska since 1982 and raised two daughters. Even though he is retiring, we don't expect Curt to disappear. Most likely he will be as busy as ever exploring Alaska and other realms.

Congratulations Curt!

EXPLORATION

Impeded by the emerging COVID-19 pandemic but buoyed by rising precious metal prices, exploration spending in Alaska totaled $145.9 million in 2020, a 15 percent decline from $171.0 million spent in 2019 (figs. 3 and 4). Alaska paralleled global trends: estimated worldwide exploration budgets decreased 11 percent to $8.7 billion, a smaller decline than might be anticipated given the scale of disturbance from the pandemic. Global exploration began the year with optimism that the U.S.–China trade war was easing; however, March 2020 brought unprecedented turmoil as the COVID-19 pandemic disrupted economic activity across the globe. Governments responded with robust economic stimulus, commodity prices began to recover, and the outlook for mineral exploration recovered during the course of the year. Capital offerings primarily targeted

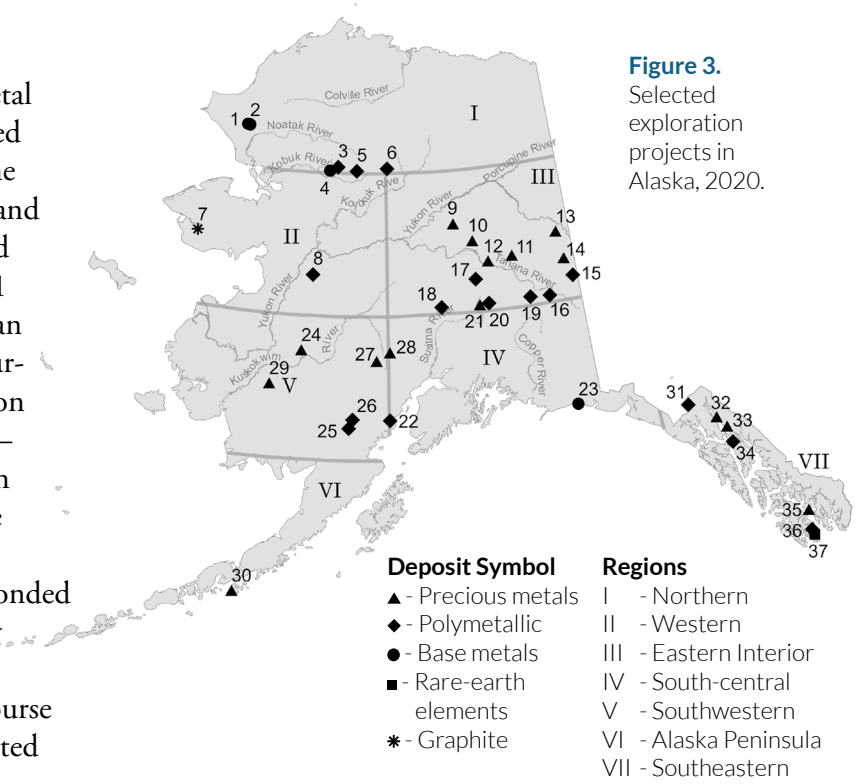


Figure 3. Selected exploration projects in Alaska, 2020.

Exploration

I. Northern Region

1. Lik—Solitario Zinc Corp. / Teck
2. Aŋarraaq-Aktigiruq —Teck
3. Arctic—Ambler Metals LLC
4. Bornite—Ambler Metals LLC
5. Sun—Valhalla Metals Inc.
6. Roosevelt—South32 Ltd.

II. Western Region

7. Graphite Creek—Graphite One Inc.
8. Illinois Creek—Western Alaska Copper & Gold

III. Eastern Interior Region

9. Tolovana District
   a. Livengood—International Tower Hill Mines Ltd.
   b. Shorty Creek—Freegold Ventures Ltd.
10. Fairbanks District
   a. Fort Knox and district—Kinross Gold Corp.
   b. Amanita—Avidian Gold
   c. Golden Summit—Freegold Ventures Ltd.
11. Goodpaster District
   a. Pogo mine area—Northern Star Resources Ltd.
   b. 64North Gold Project—Millrock Resources-Resolution Minerals
   c. Tibbs—Tectonic Metals Inc.
   d. Healy Claims—Northway Resources Corp.
12. Richardson Subdistrict
   a. SAM—GAME
13. Seventymile—Tectonic Metals Inc.
14. Napoleon—Northway Resources
15. Tanacross—Kenorland Minerals
16. Manh Choh—Kinross Gold Corp.-Contango ORE
17. Red Mountain—White Rock Minerals Ltd.
18. Golden Zone—Avidian Gold Inc.
19. Delta VMS Project—Agnico Eagle Mines Ltd.
20. Alaska Range Project—PolarX Ltd.
21. Valdez Creek Lode—Valdez Creek Mining LLC

IV. South-central Region

22. Johnson Tract—HighGold Mining Inc.
23. Icy Cape—Alaska Mental Health Trust Land Office

V. Southwestern Region

24. Donlin Gold—Donlin Gold LLC
25. Pebble—The Pebble Limited Partnership
26. Groundhog—Quaterra Resources-Chuchuna Minerals
27. Terra—WestMountain Gold Inc.
28. Estelle—Nova Minerals Ltd.
29. Nyac—Calista Corp.

VI. Alaska Peninsula Region

30. Unga—Redstar Gold Corp.

VII. Southeastern Region

31. Palmer—Constantine Metal Resources Ltd.
32. Kensington—Coeur Alaska Inc.
33. Herbert Gold—Grande Portage Resources Ltd.
34. Greens Creek Mine—Hecla Mining Company
35. Helm Bay—Agnico Eagle Mines Inc.
36. Niblack—Blackwolf Copper and Gold Ltd.
37. Bokan Mountain—Ucore Rare Metals Inc.

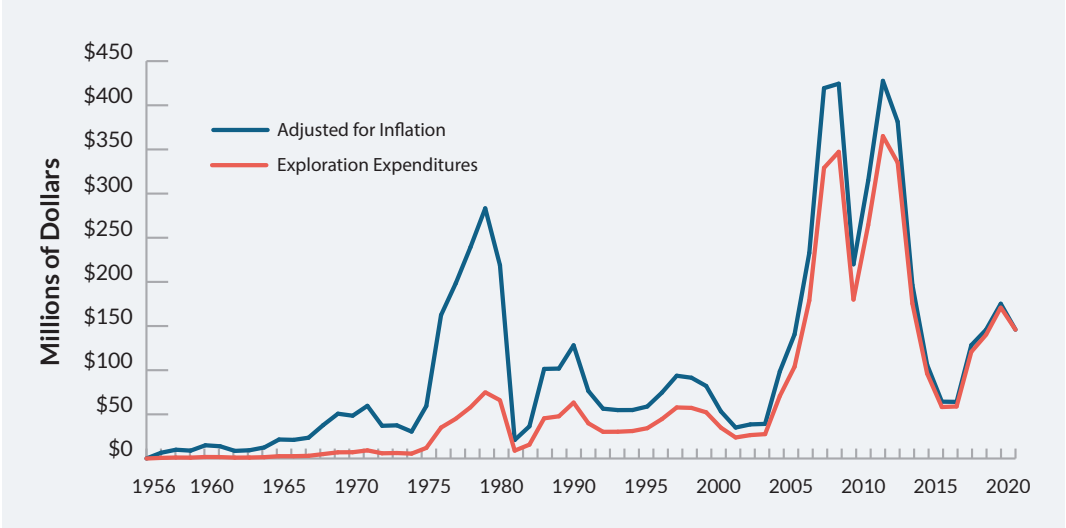


Figure 4. Alaska mineral exploration expenditures, 1956–2020. Blue line is adjusted for inflation to 2020 dollars.

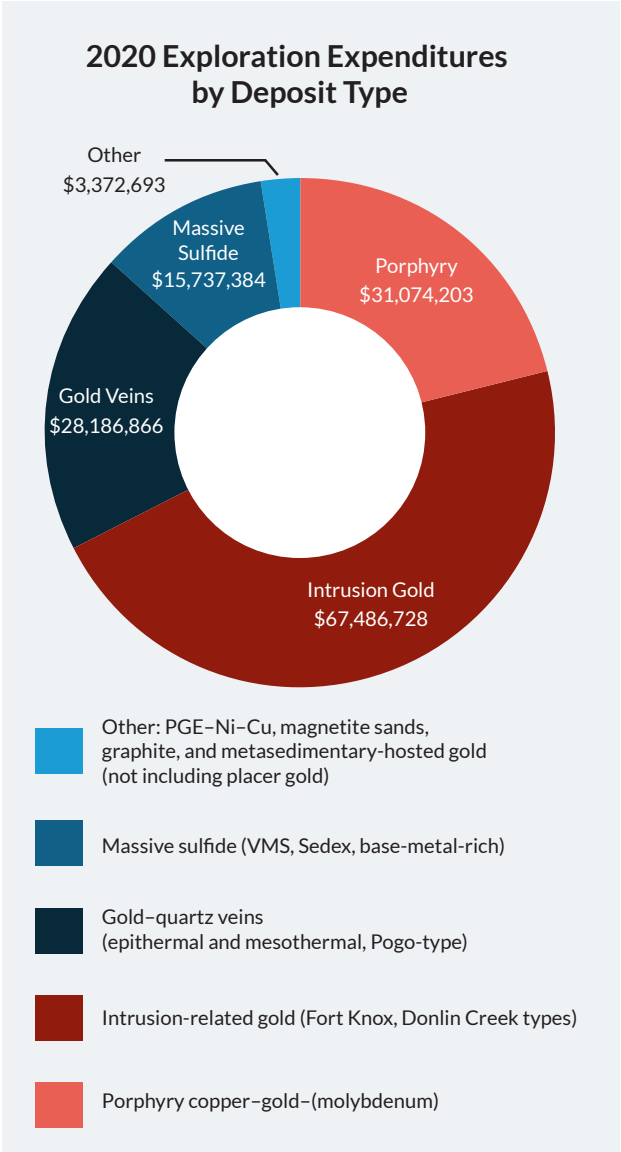


Figure 5. Exploration expenditures by deposit type, 2020.

for exploration raised $5.8 billion for the year, the highest total since 2011.[6]

Exploration for gold in Alaska surged in 2020, increasing 45 percent over 2019 levels (fig. 5; table 6). Almost 70 percent of Alaska exploration dollars were spent on gold projects, boosted by emerging projects at Estelle and 64North, as well as increased exploration at Donlin Gold, Golden Summit, Kensington, and Unga, among others. Globally, 52 percent of exploration spending targeted gold in 2020; gold and silver were the only exploration sectors to experience positive growth.[6] Exploration for base-metal and polymetallic deposits declined in Alaska, partly due to pandemic-related program cancellations in the northwest Arctic and decreased activity at Pebble, as well as a shifting emphasis towards gold at multi-commodity projects, as seen at the Red Mountain and Palmer projects.

Fifty-seven lode mineral exploration projects, some managed by the same company, reported activity in 2020. About one third of Alaska's exploration budget ($52 million) was spent on 37 early-stage exploration projects, while globally, a quarter of exploration funding went to greenfields.[6] Fifteen Alaska advanced-exploration projects and projects in the permitting stage spent $72 million, about

[6]World Exploration Trends 2021: PDAC Special Edition, S&P Global Market Intelligence, March 2021. www.spglobal.com/marketintelligence/en/news-insights/blog/world-exploration-trends-2021-report

Table 6. Reported exploration expenditures in Alaska by commodity, 1981–2020. All 2020 exploration expenditures were reported by the company; no estimates were utilized in the compilation.

	Base metals	Polymetallic[a]	Precious metals[b]	Industrial minerals	Coal and peat	Other[c]	Total
1981	$ 28,262,200	–	$ 35,273,200	$ 10,300,000	$ 2,341,000	$ 127,000	$ 76,303,400
1982	31,757,900	–	10,944,100	–	2,900,000	15,300	45,617,300
1983	9,758,760	–	20,897,555	2,068,300	1,338,454	70,000	34,133,069
1984	4,720,596	–	14,948,554	270,000	2,065,000	279,500	22,283,650
1985	2,397,600	–	6,482,400	–	270,000	–	9,150,000
1986	1,847,660	–	6,107,084	170,000	790,000	–	8,914,744
1987	2,523,350	–	11,743,711	286,000	1,150,000	31,000	15,734,061
1988	1,208,000	–	41,370,600	160,200	2,730,000	–	45,468,800
1989	3,503,000	–	43,205,300	125,000	924,296	5,000	47,762,596
1990	5,282,200	–	57,185,394	370,000	321,000	97,000	63,255,594
1991	4,789,500	–	34,422,039	92,000	603,000	2,000	39,908,539
1992	1,116,000	$ 3,560,000	25,083,000	25,000	425,000	0	30,209,000
1993	910,000	5,676,743	23,382,246	163,500	0	125,000	30,257,489
1994	600,000	8,099,054	18,815,560	225,000	2,554,000	810,000	31,103,614
1995	2,770,000	10,550,000	20,883,100	100,000	0	3,000	34,306,100
1996	1,100,000	11,983,364	31,238,600	400,000	0	0	44,721,964
1997	1,700,000	22,347,000	32,960,500	80,000	720,000	0	57,807,500
1998	1,000,000	13,727,000	42,441,000	12,000	87,000	0	57,267,000
1999	3,869,000	3,168,000	44,891,000	1,000	0	410,000	52,339,000
2000	8,545,000	3,933,000	21,579,000	58,500	0	736,100	34,851,600
2001	4,810,000	1,977,000	15,820,000	50,000	10,000	1,106,000	23,773,000
2002	1,700,000	5,162,000	17,342,000	185,000	0	2,113,000	26,502,000
2003	262,000	7,081,000	19,726,000	0	0	533,000	27,602,000
2004	3,100,000	40,237,000	26,954,000	213,000	50,000	258,000	70,812,000
2005	1,764,000	54,271,000	46,255,000	142,000	0	1,463,000	103,895,000
2006	5,069,000	81,073,000	89,793,000	20,000	2,394,000	580,000	178,929,000
2007	38,888,000	123,487,500	155,601,400	42,500	7,675,000	3,447,000	329,141,400
2008	30,116,000	163,030,000	134,885,000	0	0	19,238,000	347,269,000
2009	3,862,715	85,871,529	84,020,531	17,850	0	6,193,518	179,966,143
2010	6,392,519	122,955,321	125,364,382	19,000	6,520,200	3,104,199	264,355,621
2011	7,730,891	160,880,974	186,255,005	–	3,250,000	6,962,325	365,079,195
2012	18,161,211	150,339,009	152,444,311	–	W	14,129,838	335,074,369
2013	8,122,810	103,524,782	60,977,949	22,762	W	2,840,713	175,489,016
2014	8,310,433	29,836,240	51,759,541	32,221	W	6,300,413	96,238,848
2015	6,199,064	25,171,955	26,907,877	–	–	–	58,278,896
2016	7,820,283	25,295,705	24,857,804	–	–	912,510	58,886,302
2017	16,207,528	48,325,468	53,605,626	–	W	2,669,363	120,807,985
2018	11,932,106	57,693,015	66,168,235	–	W	4,278,600	140,071,956
2019	16,109,000	80,523,572	69,023,716	–	W	5,320,390	170,976,678
2020	–	43,517,449	100,223,594	10,000	–	2,106,830	145,857,873
Total	**$ 314,218,326**	**$ 1,493,297,680**	**$ 2,051,838,914**	**$ 15,660,833**	**$ 39,117,950**	**$ 86,267,599**	**$ 4,000,401,302**

[a]Polymetallic deposits considered a separate category for the first time in 1992.

[b]Approximately $0.94 million spent on platinum-group-element (PGE-Ni-Cu) exploration during 2014, included in the polymetallic category. Prior to 2013, PGE exploration was included in the precious metal exploration total.

[c]Includes rare-earth elements, magnetite sands, graphite, and other common deposit types.

N/A = Not available

– = Not reported

W = Withheld; data included in "Other" column

half of total exploration. Minesite exploration in Alaska fell to $22.8 million, 16 percent of total exploration and 25 percent less than 2019. This figure is significantly lower than the 41 percent spent on minesite exploration globally[6], underscoring Alaska's status as an emerging significant mining jurisdiction. Excluding Alaska's operating mines, 21 projects spent $1 million or more, for a total of $118.2 million. An additional 13 projects each spent $100,000 or more.

The 2020 Fraser Institute survey of exploration industry leaders assessed factors related to policy and permitting that affect exploration decisions in Canada, the U.S., and Australia.[2] Alaska continued to improve its Policy Perception Index ranking, an assessment of the attractiveness of mining policies in a jurisdiction, from 17th in 2019 to 13th in 2020. Independent of policy considerations, the Fraser Institute survey ranked Alaska as fifth in the world for mineral potential; only Arizona, Nevada, Turkey, and Saskatchewan were perceived as having more favorable geology. Alaska also ranked fifth in the world for overall investment attractiveness.

ALASKA'S RANKINGS
out of ~80 global mining jurisdictions[2]

5th *for overall investment attractiveness*	**5th** *for mineral potential*
13th *for attractiveness of mining policies*	**16th** *for geological databases*

The total area of the State covered by mining claims and prospecting sites in 2020 increased by fifteen percent to over four million acres (table 7). Total area of State mining claims increased 14 percent to 3.8 million acres, while total Federal mining claims increased two percent to 126,240 acres. The total number of active 40-acre claims decreased by 13 percent while the number of 160-acre claims increased by 22 percent. Inventory of State prospecting sites, which expire two years after initial staking, increased by 347 percent.

Northern Region

Aŋarraaq–Aktigiruq

Teck Alaska Inc. paused exploration at their Aŋarraaq deposit and Aktigiruq prospect, which lie about eight miles northwest of Red Dog mine (photo 4). The Aŋarraaq deposit holds an inferred resource of 21 million tons grading 14.4 percent zinc, 4.2 percent lead, and 2.13 ounces of silver per ton (appendix D). Preliminary exploration of the nearby Aktigiruq target suggests a potential resource in the range of 88–165 million tons of mineralization grading 16–18 percent combined zinc plus lead. If confirmed, Aktigiruq would be one of the largest undeveloped zinc deposits in the world, comparable in total size to all past production and current reserves at Red Dog mine.

Lik

Teck and 50 percent co-owner Solitario Zinc Corp. took the year off from exploration at the Lik zinc–lead–silver sediment-hosted massive sulfide deposit northwest of Red Dog mine (photo 4). Lik hosts two massive sulfide deposits with a total indicated and inferred resource of 25.85 million tons grading 8.23 percent zinc, 2.72 percent lead, and 1.16 ounces of silver per ton (appendix D).

Ambler Mining District

Upper Kobuk Mineral Projects

The Upper Kobuk Mineral Projects (UKMP) is located within the Ambler Mining District (AMD) in the southern Brooks Range and hosts world-class polymetallic VMS deposits (including Arctic) that contain copper, zinc, lead, gold, and silver, and carbonate-replacement deposits (including Bornite) that host high-grade copper and cobalt mineralization. On February 11, 2020, Trilogy Metals Inc. completed the formation of a 50/50 joint venture with Australia-based South32 Limited. The new operating company is named Ambler Metals LLC. Trilogy contributed all its UKMP assets, including the Arctic and Bornite deposits, while South32 contributed $145 million.

In parallel with UKMP exploration, the Ambler Mining District Industrial Access

Table 7. Summary of claim activity, 1991–2020. The figures in this table may change as data are reviewed and updated.

	State Claims				State Prospecting Sites (160 acres)		Federal Claims (20 acre sites)	
Year[a]	New (Active) 40 acre[b]	New (Active) 160 acre	Total (Active) 40 acre[b]	Total (Active) 160 acre	New	Total	New	Total
1991	3,277	0	37,862	0	747	1,723	1,299	23,222
1992	2,640	0	36,250	0	454	1,472	695	20,254
1993	2,120	0	34,340	0	1,412	2,259	601	9,298
1994	4,057	0	34,400	0	802	2,378	341	8,495
1995	4,512	0	30,464	0	1,030	2,725	376	7,766
1996	9,489	0	36,602	0	2,082	3,687	681	9,346
1997	8,678	0	42,836	0	2,480	5,305	1,872	11,320
1998	9,786	0	49,816	0	3,194	7,148	427	11,033
1999	11,978	0	56,107	0	1,755	7,600	308	10,176
2000	4,560	614	54,393	614	1,143	5,675	523	7,805
2001	858	907	49,627	1,503	27	3,091	464	8,248
2002	745	826	44,056	2,179	61	2,138	261	8,100
2003	856	2,603	38,076	4,387	101	1,857	676	8,424
2004	1,070	3,533	34,380	7,719	59	1,484	66	8,313
2005	806	4,502	34,066	11,551	128	1,612	411	7,826
2006	1,111	5,747	33,864	16,249	103	1,646	457	8,068
2007	576	6,031	31,305	20,208	57	1,625	933	8,872
2008	1,333	2,565	23,033	13,519	24	651	3,001	11,732
2009	1,142	2,793	24,340	16,381	40	335	1,057	10,431
2010	1,446	6,132	24,805	20,389	88	441	332	8,413
2011	1,932	4,893	24,319	21,970	180	273	284	8,438
2012	1,638	3,478	24,673	20,810	202	409	632	—
2013	1,622	2,155	24,883	17,347	28	209	289	6,916
2014	1,219	677	25,479	15,250	19	197	69	6,003
2015	1,014	711	26,493	15,961	21	36	71	6,074
2016	1,164	893	21,303	9,887	21	31	37	5,656
2017	1,713	3,453	22,175	12,074	44	85	695	6,259
2018	1,083	2,319	19,757	17,948	23	113	87	6,248
2019	1,063	3,508	19,245	16,303	90	131	90	6,216
2020	1,357	3,613	16,721	19,880	577	586	135	6,312

Information provided by Alaska Department of Natural Resources and U.S. Bureau of Land Management. The figures in this table will change as data are reviewed and updated.

[a]After 2010, State claim and prospecting site totals are not directly comparable to previous years. After 2016, new State prospecting sites and total prospecting sites are not directly comparable to previous years.

Claim totals comprise Mining Claims (including "River Bottom Navigable" subtype) and Leasehold Locations whose claimants filed an Annual Affidavit of Labor, and claims initiated on State-selected land. There were 1,574 active 40-acre claims and 1,500 active 160-acre claims on State-selected land in 2020, as compared with 70 active 40-acre claims and 90 active 160-acre claims on State-selected land in 2019.

[b]Includes claim fractions varying from 1 to 39 acres.

— = Not reported

Photo 4. Aerial overview of the Red Dog mine in the Northwest Arctic Borough, showing the names and surface-projected footprints of the major orebodies in the district. The view is to the northwest. Aŋarraaq and Lik lie about eight and eleven miles from Red Dog mine, respectively. Last accessed December 6, 2021; excerpted from presentation at www.teck.com/media/P6-Exploration-Part-2.pdf.

Project (AMDIAP) is being implemented to provide future road access to the AMD to unlock its mineral and economic potential. On March 27, 2020, the BLM, the lead Federal agency for permitting the AMDIAP, released the Final Environmental Impact Statement (EIS) for the AMDIAP. On June 24, 2020, AIDEA approved a Memorandum of Understanding with Ambler Metals LLC, which specifies how the two parties will jointly establish a plan regarding the permitting, feasibility, engineering and design, construction and operation, financing, and closure of the AMDIAP; their initial agreement calls for both parties to contribute $35 million each for these activities. In 2020, they equally contributed about $1 million for engineering and planning work. AIDEA completed a lidar survey, aerial photography, and cultural resource work.

On July 23, 2020, the BLM issued the Joint Record of Decision (JROD) for the AMDIAP. Along with the JROD, a Section 404 permit that is governed by the Clean Water Act was issued by the U.S. Army Corps of Engineers (USACE) to AIDEA. The JROD selects the road alternative that is the most direct route from the Dalton Highway to the Ambler Mining District. It is the environmentally preferred alternative, having the smallest footprint (~4,500 acres) and least impact on wetlands. The Final EIS includes a suite of mitigation measures that are adopted in the JROD and will be included in the subsequent right-of-way permit.

The COVID-19 pandemic caused Ambler Metals LLC to defer their planned 2020 field-based exploration programs until 2021; however, progress was made at their Arctic and Bornite deposits, and elsewhere in the UKMP area.

Arctic

In August, Trilogy Metals Inc. announced results of a new Feasibility Study (FS) for the Arctic Deposit (appendix D), demonstrating the technical and economic viability of establishing a conventional open-pit copper–zinc–lead–silver–gold mine and mill complex operating at 11,000 tons per day over a 12-year mine life. The FS forecasts an average annual payable production to be more than 155 million pounds of copper, 192 million pounds of zinc, 32 million pounds of lead, 32,165 ounces of gold, and 3.4 million ounces of silver. Total life-of-mine production is projected at 1.9 billion pounds of copper, 2.3 billion pounds of zinc, 388 million pounds of lead, 386 thousand ounces of gold, and 40.6 million ounces of silver.

Conventional milling and flotation processes will produce copper, zinc, and lead concentrates. Based on feasibility-level metallurgical work, average recoveries are projected to be 89.9 percent for copper, 90.6 percent for zinc, and 79.0 percent for lead, in their respective concentrates. Over 60 percent of the recovered payable silver and gold report to the lead concentrate at 95 percent payable.

Life-of-mine strip ratio is approximately 6.9 to one. Initial capital expenditure of $906 million and sustaining capital of $114 million yield total estimated capital expenditures of $1,020 million. Closure and reclamation costs are estimated at $205 million. Estimated pre-tax and after-tax payback of initial capital are 2.4 years and 2.6 years, respectively.

The Arctic FS resulted in a pre-tax Net Present Value using a discount rate of eight percent (NPV8%) of $1.6 billion and an Internal Rate of Return (IRR) of 31 percent for the base case and an after-tax NPV8% of $1.1 billion and after-tax IRR of 27 percent for the base case. The base case scenario utilized $3.00 per pound for copper, $1.10 per pound for zinc, $1.00 per pound for lead, $1,300 per ounce for gold, and $18.00 per ounce for silver.

Under an agreement with NANA Regional Corporation, Inc., NANA has the right, following a construction decision, to elect to purchase a 16- to 25-percent direct interest in the Arctic project or, alternatively, to receive a 15 percent Net Proceeds Royalty (NPR). The FS was carried out on a 100-percent ownership basis and does not include the impact if NANA elects to purchase an interest in the Arctic project or, alternatively, the impact if the NPR becomes applicable. The FS includes the 1.0 percent Net Smelter Royalty to be granted to NANA in exchange for a surface-use agreement.

Bornite

The Ambler Metals joint venture paused drilling at its Bornite carbonate-hosted copper–cobalt deposit during 2020. The company updated the geological model to incorporate 2019 drill-program results and collected and submitted five additional composite samples from the below-pit (South Reef) resource area for metallurgical test work.

District-Wide Exploration

Exploration by Ambler Metals in the broader AMD included initiating metallurgical test work and updating the Sunshine prospect geological model to incorporate 2019 drill results. Ambler Metals also compiled regional historical data from the Ambler VMS Belt and, utilizing prior geophysical surveys, developed 3D geologic models of the most promising prospects and prospect areas.

Sun

Valhalla Metals Inc. reported no exploration at its Sun property during 2020. The property includes the 11.8-million-ton Sun deposit (appendix D) and several other prospects and targets.

Roosevelt

South32 Ltd. expanded its footprint in the Ambler VMS Belt in 2020, staking 202,880 acres of State land including the Roosevelt Creek prospect and other prospective land east of the

company's Ambler Metals joint venture. Roosevelt Creek was discovered by Anaconda Alaska in the late 1970s and drill tests at that time intercepted massive sulfide mineralization. The property has been largely inactive since that time. South32 flew a 2,205-line-mile helicopter-borne VTEM survey over the claim block in 2020. The survey detected numerous conductive anomalies coincident with historical stream sediment anomalies and will form the basis for follow-up exploration of the property in the coming years.

Western Region

Graphite Creek

The advanced-exploration stage Graphite Creek project, located 34 miles north of Nome, hosts the United States' largest large-flake graphite deposit. Although COVID-19 concerns led to reining in most activities during the last half of 2020, Graphite One made progress on their Prefeasibility Study (PFS) and environmental baseline work. Their PFS will address all aspects of a production-scale processing flow sheet that includes primary beneficiation of graphite material to the concentrate stage and secondary processing of graphite concentrate to demonstrate the full portfolio of finished products.

In addition to Graphite One's primary focus on the electric-vehicle batteries and energy-storage systems markets, preliminary test work performed by an independent industrial partner using graphitic material from the Graphite Creek deposit indicates multiple potential additional value-added products. Primary processing of 12,000 pounds of graphitic material produced a graphite concentrate, which was then purified and processed into a broad range of value-added grades. Samples have been sent to potential customers either as conceptual samples or complete feasibility products.

Illinois Creek

Western Alaska Copper & Gold continued exploration of the Illinois Creek property, located 55 miles south of Galena in western Alaska. The Illinois Creek property hosts the past-producing Illinois Creek mine, the Round Top copper porphyry prospect, and other prospects. In 2020, the company drilled 73 reverse-circulation holes (2,110 feet total) in the historical Illinois Creek heap leach pad. The company will use information obtained from drilling to add to the mineral resource base of the property (appendix D).

Eastern Interior

Fairbanks District

Fort Knox

Exploration drilling continued ahead of production at Kinross Gold Corporation's Fort Knox gold mine 20 miles north of Fairbanks. Exploration drilling focused on the Gil–Sourdough deposit eight miles east of Fort Knox, with continued drilling in the western and eastern resource areas of the Fort Knox mine. Generative exploration also tested early-stage targets northeast of the Fort Knox property. Exploration drilling totaled approximately 28,000 feet.

Drilling, pit optimization, and an increase in the resource gold price assumption added 563,000 ounces of gold to measured and indicated resources and a net increase of 283,000 ounces of gold to the inferred resource, with a large portion attributed to the increase in gold price (appendix D).

Resource definition drilling at the Gil–Sourdough deposit in 2020 sought to convert and upgrade resources to mineral reserves within the scoping-level pit design and the West North Gil extension zone. Kinross announced plans to begin mining the Gil deposit in 2021. Ore will be trucked to the Fort Knox mill; the deposit is expected to produce 160,000 ounces of gold over a two-year mine life.

Amanita

Avidian Gold's Amanita property north of Fairbanks lies approximately four miles southwest of the Fort Knox gold mine. Like Fort Knox, the property is underlain by schist and mid-Cretaceous granite, and northeast-trending faults that run through Fort Knox also transect the Amanita property. In 2020, the company tested the northeast-striking structure with nine oriented core

holes totaling 6,382 feet along a strike length of 5,000 feet. Over 1,400 samples were taken from drill core. Near-surface gold mineralization was encountered in all holes. Highlights include AM20-02, with 89.2 feet grading 0.100 ounce of gold per ton, and hole AM20-03, with 79.4 feet of 0.042 ounce of gold per ton, including a higher-grade intersection of 18.9 feet grading 0.084 ounce of gold per ton. Avidian also completed a high-resolution helicopter-based lidar and orthophoto survey over the entire property, conducted 275.6 line-miles of drone-based magnetic surveying at 82- to 164-foot line spacing, and sampled newly discovered subcrop exposures.

Golden Summit

Freegold Ventures Ltd. resumed exploration drilling at its intrusion-related Golden Summit property approximately five miles north of the Fort Knox mine near Fairbanks (photo 5). Freegold has defined a bulk-tonnage resource of 2.9 million ounces of gold (appendix D) associated with the Dolphin intrusive, and the company completed a preliminary economic assessment (PEA) of the project in 2016.

Following an extensive data review, Freegold identified potential for a higher-grade corridor between the Dolphin intrusive and the high-grade veins at the historical Cleary Hill mine. The initial test of this concept began in February 2020, and the first hole GSDL2001 intercepted 616 feet averaging 0.108 ounce of gold per ton. Veins, veinlets, and stockwork zones within areas of intense silicification indicate a robust vein-swarm system. Follow-up drilling, including 18 holes completed during 2020, has continued to intercept broad zones of mineralization at grades higher than the previously calculated resource.

Photo 5. Freegold Ventures geologists log core at the Golden Summit project north of Fairbanks. Last accessed December 6, 2021; www.freegoldventures.com/golden-summit/image-gallery/.

Goodpaster District

Pogo

Despite the impacts of COVID-19, Northern Star Resources Ltd. continued to grow its resource base at the Pogo mine 38 miles northeast of Delta Junction. At the end of 2020, Pogo had resources of 6.9 million ounces of gold, the highest resource base in the history of the mine (appendix D). Reserve definition kept pace with mining, standing at 1.5 million ounces of gold in 2020.

Underground drilling within the mine area focused on reserve definition across all major production areas. The definition program also yielded well-mineralized intercepts from unmodeled structures, particularly in the Liese 2 and South Pogo areas (photo 6). Surface exploration drilling focused on the Goodpaster prospect, including core drilling on the eastern end of the Goodpaster trend to define potential resource areas for further evaluation. Elsewhere in the district, Northern Star Resources partnered with DGGS on a helicopter-borne aeromagnetic survey.

64North Gold Project

The 64North Gold Project is a joint venture of Millrock Resources Inc. and Resolution Minerals Ltd. of Australia, formed to explore claims adjoining Northern Star Resources' Pogo gold mine (photo 7). The companies formed the joint venture late in 2019 and commenced exploration in early 2020, with Resolution earning its initial 30 percent stake by spending more than $5 million and paying $50,000 to Millrock.

At the West Pogo block (Aurora, Reflection, and Echo targets), the partners drilled nine core holes totaling 15,675 feet to test geophysical targets along the southwestward-projected continuity of Northern Star's recent Goodpaster vein discovery. The drilling intersected a system of

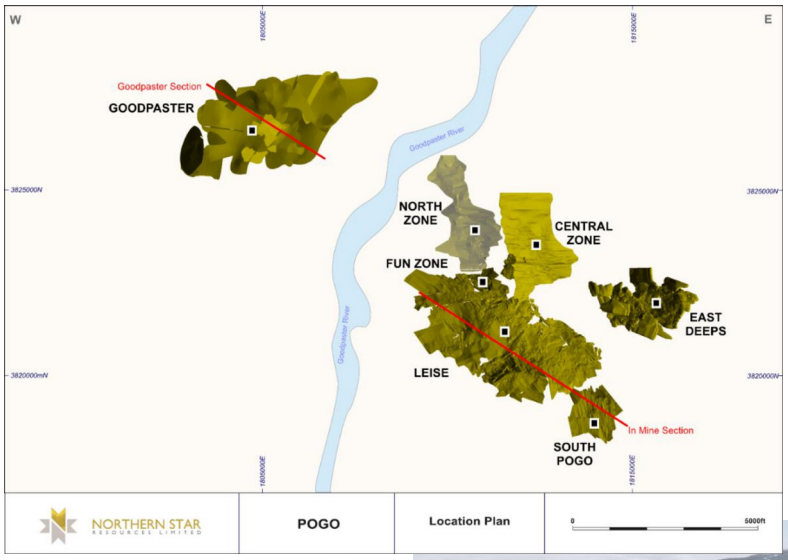
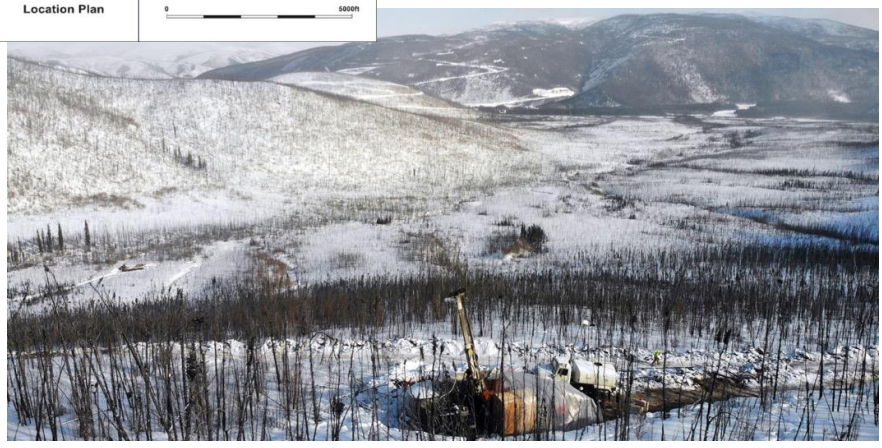


Photo 6, left. Plan view of resource zones at the Pogo mine near Delta Junction. Image from Northern Star Resources news release dated May 3, 2021. Last accessed January 19, 2022; www.nsrltd.com/investor-and-media/asx-announcements/2021/may/resources,-reserves-and-exploration-update.

Photo 7, below. Drilling by Resolution Minerals at the 64North Gold Project in March, 2020, with the Pogo mine in the background. Last accessed December 6, 2021; www.resolutionminerals.com/investor-center/exploration-update-64north-project-alaska-may-2020/.



quartz–sulfide veins and vein breccias similar to the Goodpaster mineralization with anomalous—but not ore grade—gold, accompanied by pathfinder elements arsenic, bismuth, and tellurium. Also on the West Pogo block, a drill road cut mineralized granite bedrock at the Sunrise prospect, yielding a 305-foot continuously sampled interval averaging 0.0085 ounce of gold per ton.

At the East Pogo block, the partners completed airborne magnetic and ZTEM geophysical surveys, a ground-based CSAMT (controlled-source audio-frequency magnetotellurics) geophysical survey, mapping, and surface sampling in preparation for a 2021 drill program. At the Eagle Block, a Fort Knox-style intrusion-related gold prospect, they completed a high-resolution aeromagnetic survey and excavated four trenches (2,350 feet total), sampling 39 feet grading 0.006 ounce of gold per ton and 85 feet grading 0.003 ounce of gold per ton. The companies completed a prospecting and surface geochemical sampling program at the North Pogo and Divide blocks.

Tibbs

Tectonic Metals, Inc. continued rotary air blast (RAB) exploration drilling at their Tibbs gold project 22 miles east of the Pogo mine. Mineralization at Tibbs comprises high-grade, near-surface gold hosted by both high- and low-angle quartz–pyrite–arsenopyrite–stibnite veins and sheeted-to-stockwork quartz–sulfide veins. In 2020 Tectonic sought to expand on its 2019 success at the Michigan zone, which included a RAB intercept of 95 feet averaging 0.18 ounce of gold per ton. The company drilled 27 holes (10,505 feet) during 2020, with 16 holes testing Lower Trench and Wolverine for the first time since 1997. Highlights include an intercept of 0.13 ounce of gold per ton over 25 feet at Lower Trench; the character of this mineralization is very similar to that seen at the Michigan zone located 5,000 feet to the southeast. Tectonic also completed RAB drilling and an IP geophysical survey at the Michigan zone, as well as prospecting and mapping at the nearby Maple Leaf and Mount Harper properties.

Healy Claims

Northway Resources Corp. conducted a program of geophysical and geochemical exploration at its Healy gold property, located 29 miles southeast of the Pogo mine in the Goodpaster Mining District. The company explored multiple targets on the property using soil sampling, ground magnetometer and very low frequency (VLF) surveying, and IP surveying. Northway also participated in the State of Alaska's helicopter-borne magnetic and radiometric survey effort in the Goodpaster Mining District.

Richardson Subdistrict

SAM

Great American Minerals Exploration, Inc. (GAME) conducted a 74-hole, 21,000-foot core and RC drill program at its consolidated SAM gold project in the Richardson mining subdistrict between Fairbanks and Delta Junction (photo 8). The program focused on upgrading the gold resources at the Naosi deposit and testing other targets across its consolidated Montecristo–Uncle Sam property. GAME also built roads on the property, conducted soil and rock sampling, and progressed environmental baseline and metallurgical studies. The Naosi deposit hosts an inferred mineral resource of 1.5 million ounces of gold at an average grade of 0.1 ounce of gold per ton;

Photo 8. Gold-bearing vein material in drill core at GAME's SAM gold project near Delta Junction. Photo courtesy of Dennis McDowell, SAM Alaska, LLC.

of this total, an estimated 691,000 ounces are in oxidized rock, with the balance in refractory sulfide-bearing rock (appendix D).

Tolovana District

Livengood

International Tower Hill Mines Ltd.'s (ITH) Livengood gold project is an advanced-exploration-stage, intrusion-related gold deposit located 75 road miles northwest of Fairbanks. Under the mining scenario presented in the 2017 PFS, the deposit has combined reserves and resources totaling 637 million tons at an average grade of 0.020 ounce of gold per ton, a total of 12.6 million ounces of contained gold (appendix D). In 2020, the company began work on an updated PFS, expected in late 2021, that will incorporate new metallurgical results, resource modeling, and other advances that have occurred since the release of the previous 2017 PFS.

Shorty Creek

South32 Ltd. continued its joint venture agreement to explore Freegold Ventures Limited's Shorty Creek prospect, an intrusion-related, copper–gold–silver–tungsten property approximately 75 road miles northwest of Fairbanks. The companies refined their drill targets in 2020, with drilling to resume in 2021.

Manh Choh Project (formerly Peak Gold)

The year 2020 marked both transition and progress for the Manh Choh gold–silver project (formerly known as the Peak Gold project), located on Tetlin native lands 11 miles south of Tok. The skarn deposit hosts measured plus indicated resources of 1.2 million ounces of gold at an average grade of 0.12 ounce of gold per ton and 4.2 million ounces of silver at an average grade of 0.41 ounce of silver per ton (appendix D, listed as 'Tetlin').

In January of 2020, veteran Alaska geologist and businessman Rick van Nieuwenhuyse joined joint venture majority owner Contango ORE as President and CEO. In a series of transactions announced September 30, Kinross Gold Corp. purchased Royal Gold's 40 percent share of the project and half of Contango ORE's 60 percent share, resulting in Kinross owning 70 percent and assuming operatorship of the project. Royal Gold retains a three percent net smelter return (NSR) royalty on future gold production. The landowner, the Tetlin Tribe, retains a three percent net production royalty on the first four years of full-scale production, escalating thereafter, subject to deduction of previous expenses against future royalty receipts.

With the completion of the deal with Kinross, the joint venture announced its intention to develop the project by trucking the ore to the Fort Knox mill in Fairbanks, 250 miles away. This scenario avoids the capital costs and extended timelines associated with the design, construction, and permitting of on-site processing and tailings storage facilities. A feasibility study is expected in 2022, followed by construction in 2023, and full-scale production in 2024. The mine is anticipated to produce approximately one million ounces of gold over a four-and-a-half-year mine life.

With engineering and permitting deadlines looming, Kinross began its work on the property with a late-2020 program of metallurgical and geotechnical drilling (photo 9). A much larger resource upgrade and engineering drill program is planned for 2021, as well as finalization of environmental and cultural studies in preparation for permit application submittal late in 2021.

Photo 9. Tetlin Tribal members logging core the Manh Choh gold project near Tok. Photo courtesy of Brenna Schaake, Kinross Gold Corp.

Seventymile

Tectonic Metals, Inc. continued exploration at its Seventymile shear-zone-hosted gold project, located 40 miles west of Eagle. The project includes the Flanders, Alder Creek, and Bonanza Creek lode prospects, among others, and is leased from underlying landowner Doyon, Ltd. In 2020 Tectonic completed a 26-hole, 8,500-foot, RAB drill program targeting the five-mile-long Flume orogenic gold trend. The company successfully tested geochemical targets as well as extensions and infill on known prospects, validating its structural interpretation. Highlights include 0.060 ounce of gold per ton over 20 feet at the previously undrilled Flume–Bonanza zone, and an infill hole at the Flanders zone returned 0.128 ounce of gold per ton over a 20-foot intercept.

Tanacross

Kenorland Minerals' Tanacross project comprises a cluster of porphyry-type prospects about 55 miles northeast of Tok, including the Taurus, Bluff, East Dennison, Pushbush, and Big Creek prospects. After a significant drilling and geophysical program in 2019, the company reported a care-and-maintenance program for 2020.

Golden Zone

Avidian Gold Alaska Inc.'s Golden Zone property, 25 miles southwest of Cantwell and accessed off the Parks Highway, contains numerous igneous-related mineral occurrences over a 9.3-mile strike length. The property's Golden Zone Breccia Pipe deposit has an NI 43-101-compliant resource of 6.1 million tons grading 0.05 ounce of gold per ton and 0.247 ounce of silver per ton: 303,300 ounces of gold and 1,509,200 ounces of silver (appendix D). In 2020 Avidian flew a helicopter-based lidar and orthophoto survey over the entire Golden Zone property, conducted a 365.8-line-mile drone-based magnetic survey over the northern portion of the property covering the Breccia Pipe deposit area, and staked 4,880 acres of new claims adjacent to the southwest end of their claim block.

Alaska Range Project

PolarX's Alaska Range project comprises a collection of copper- and gold-bearing deposits and prospects accessed from the Denali Highway between Paxson and Cantwell. These include the sediment-hosted-copper Caribou Dome deposit (3.1 million tons grading 3.1 percent copper; appendix D); the Zackly gold–copper skarn deposit (3.75 million tons grading 1.2 percent copper, 0.058 ounce of gold per ton, and 0.409 ounce of silver per ton; appendix D); and the Saturn, Jupiter, Mars, and Gemini porphyry copper–gold–molybdenum targets. In 2020 PolarX conducted exploration and resource-expansion drilling at the Zackly skarn deposit, a 288-line-mile drone-based aeromagnetic survey, and ongoing environmental baseline studies and road maintenance.

Red Mountain

White Rock Minerals Ltd. emphasized early-stage exploration for both gold and massive sulfides at its Red Mountain project in the northern Alaska Range in 2020. The property hosts an array of zinc–lead–copper–silver–gold-bearing VMS deposits and prospects, the best known of which are the Dry Creek deposit (2.6 million tons; appendix D) and the West Tundra Flats deposit (7.4 million tons; appendix D). In 2020, the company focused its attention on the Last Chance prospect, a newly defined gold target identified by stream sediment sampling in 2019. Geological reconnaissance identified gold–arsenic–antimony-bearing quartz-cemented breccias and veins in the area. White Rock flew a 1,680-line-mile airborne magnetic and radiometric survey over the target, collected four lines of CSAMT, and made the initial test of several of the most promising targets with an eight-hole, 6,530-foot diamond drilling program. The drilling intercepted multiple intervals of low-grade gold mineralization associated with quartz–arsenopyrite veins, breccias, and silicification.

In addition to the work at Last Chance, prospecting by White Rock also identified six new VMS-type massive sulfide occurrences. These

pyrrhotite- or pyrite-rich massive sulfide outcrops yield locally high grades of zinc, lead, copper, silver, and gold; none are known to have been tested by drilling.

Valdez Creek Lode

The Valdez Creek gold lodes lie in the headwaters of the Valdez Creek placer deposits in the south-central Alaska Range. Historical exploration identified five vertically stacked, gold-bearing zones over a vertical distance of 600 feet with a strike length of over 900 feet. The claims are currently being explored by Valdez Creek Mining LLC, who in 2020 conducted a program of soil, rock, and stream sediment sampling, reconnaissance mapping, and a 449-line-mile helicopter-borne VTEM magnetic and electromagnetic geophysical survey.

Delta VMS Project

The Delta mineral belt, approximately 35 miles west of Tok, hosts VMS mineralization with inferred resources totaling 18.8 million tons at average grades of 4.5 percent zinc, 0.6 percent copper, 1.9 percent lead, 1.96 ounces of silver per ton, and 0.048 ounce of gold per ton (appendix D). In 2020 property owner Agnico Eagle Ltd. worked to define drill targets through surface sampling, satellite data collection, and modeling of existing geophysical data (photo 10).

Napoleon

The Napoleon project is an early-stage, high-grade lode gold prospect in the Fortymile Mining District near Chicken. The prospect was drilled in the late 1990s and early 2000s; intercept highlights include two feet grading 1.01 ounces of gold per ton and 9.8 feet grading 0.248 ounce of gold per ton. Northway Resources acquired the prospect by staking in 2018. To jump start their program, Northway procured several existing proprietary exploration databases for the Napoleon project area. In July 2020 Northway completed a surface-exploration program, including geochemical and geophysical surveys. A VLF and magnetic survey was completed over areas of historical drilling to delineate prospective structural features related to the area's high-grade, gold-bearing quartz veins. In addition, field teams collected 550 infill soil samples over select target areas to refine gold-in-soil anomalies.

Photo 10. A pilot sanitizes the helicopter between crew flights at the Delta VMS project near Tok. Photo courtesy of Greg Johnson, Agnico Eagle (USA) Ltd.

South-Central Region

Johnson Tract

The Johnson Tract (JT) gold and base-metal deposit lies 125 miles southwest of Anchorage. The property was discovered by Anaconda in 1982 and is being explored by HighGold Mining Inc. under a lease agreement with Cook Inlet Region, Inc. (CIRI). Geologically, it comprises gold–silver–zinc–copper–lead mineralization associated with quartz stockworks and is hosted in Jurassic volcaniclastic rocks; mineralization is interpreted to have formed in a sub-seafloor setting contemporaneous with the host stratigraphy. There are at least nine other altered and (or) mineralized prospect areas over a 7.5-mile strike length (photo 11).

In early 2020, HighGold announced an initial indicated mineral resource of 2.4 million tons at an average grade of 0.18 ounce of gold per ton, 0.17 ounce of silver per ton, 5.85 percent zinc, 0.57 percent copper, and 0.8 percent lead, for

Photo 11. HighGold Mining Inc. drills a target along the trend of the JT deposit (foreground), western Cook Inlet. Photo courtesy of Brodie Sutherland, HighGold Mining Inc.

a total 417,000 ounces of gold, or 750,000 ounces "gold-equivalent" when including the other metals.

HighGold explored the property aggressively in 2020, drilling 53,875 feet in 37 holes plus regional reconnaissance and target definition through surface work and direct-current induced polarization (DCIP) geophysical surveys. Drilling focused on resource expansion step-outs at the JT deposit and on the delineation of the Footwall Copper Zone, which was discovered in 2019. The company also tested the Northeast Offset target with several drill holes, resulting in the discovery of locally high-grade mineralization of a style different than that seen at the JT deposit. Surface sampling at the Difficult Creek (DC) prospect identified a new silver-rich vein zone, returning grab sample assay highlights ranging from five to 50 ounces of silver per ton.

Icy Cape

Icy Cape is a gold- and heavy mineral beach-placer prospect located in the Gulf of Alaska near Icy Bay, about 75 miles northwest of Yakutat. The land is owned by the Alaska Mental Health Trust Authority and managed by the Trust Land Office (TLO). The TLO's Icy Cape Gold and Industrial Heavy Minerals project is a staged, incremental effort to evaluate the potential for producing industrial heavy minerals (garnet, epidote-group minerals, magnetite, ilmenite, zircon, rutile) as part of a placer gold operation. Recent work includes testing garnet and epidote concentrates to demonstrate their marketability as abrasive and water-filtration medias. In 2020 TLO calculated mineral resource estimates and commissioned an independent review of the project's economics; on-site work, including magnetic surveys and resource definition drilling, is scheduled to resume in 2021.

Southwestern Region

Donlin

Donlin Gold, a proposed large open-pit gold mine in southwest Alaska, is a 50/50 partnership between Barrick Gold Corp. and NovaGold Resources Inc. The deposit contains proven and probable reserves of 34 million ounces of gold at an average grade of 0.06 ounce of gold per ton (appendix D) and would be one of the world's largest gold mines if built.

In 2020 Donlin Gold conducted its largest drill program in 12 years, with 85 holes drilled totaling 76,772 feet in the ACMA and Lewis

deposit areas. The objective was to validate recent geologic- and resource-modeling concepts and to test potential extensions of high-grade zones focused on early-stage mining areas. Results from both the ACMA and Lewis deposit areas exceeded modeled grade-thickness, with higher grades observed over narrower intervals, particularly in sedimentary rocks.

To power the planned Donlin mine site, Donlin Gold is proposing a 316-mile-long natural gas pipeline originating at Cook Inlet. They received the final State Right-of-Way (ROW) authorization for the proposed pipeline, issued by DNR, in January of 2020. Also that month, DNR issued final authorization of the easements for the access road, fiber optic cable, and other transportation facilities on State lands. In April, DNR's Division of Oil & Gas agreed to reconsider its decision on the State ROW agreement and lease authorization, and in September the DNR issued a revised Consideration of Comments document. The document further describes how DNR is considering previous public input solicited during the ROW review, including how cumulative effects are addressed in the decision. In December, DNR took public comments on Donlin Gold's 12 applications for water rights associated with the mine site and transportation facilities.

Pebble

The year 2020 marked significant regulatory, political, and other actions affecting the Pebble porphyry copper–gold–molybdenum deposit in southwestern Alaska, one of the world's largest undeveloped mineral resources. The project is being advanced by the Pebble Limited Partnership (PLP), a wholly owned subsidiary of Northern Dynasty Minerals, Ltd. The deposit comprises two zones, the surface-minable Pebble West and the larger and higher-grade Pebble East, which would require underground block-cave mining. Combined, the deposit has a total mineral resource (all categories) of 82.0 billion pounds of copper, 106.5 million ounces of gold, and 5.6 billion pounds of molybdenum (appendix D).

In August 2020 PLP released a new resource calculation for rhenium (Re), a critical mineral used in high temperature alloys in jet aircraft engines. PLP reports a measured plus indicated resource of 5.8 million pounds Re and inferred resource of 3.5 million pounds Re.

PLP continued its community relations work during 2020, announcing a new local revenue sharing program to ensure full-time residents of communities in southwest Alaska benefit directly from the future operation of the proposed Pebble mine. PLP and Alaska Peninsula Corporation (APC) signed a Memorandum of Understanding to position APC as the organizer of a consortium of key Iliamna Lake area village corporations to provide transportation and port operations support for the proposed mine.

In December 2017, PLP initiated the Federal and State permitting process for a reduced-scope mining plan that would exploit the Pebble West orebody over a 20-year mine life (photo 12). This scenario would produce 7.4 billion pounds of copper, 12.1 million ounces of gold, and 398 million pounds of molybdenum from approximately 1.3 billion tons of ore. Cyanide would not be used for secondary gold recovery. The footprint of major mine facilities would be reduced to 5.3 square miles, and no facilities would be built in the Upper Talarik Creek drainage. The company has not completed

Photo 12. Environmental studies by Northern Dynasty are ongoing at the Pebble Project in southwest Alaska. Last accessed December 6, 2021; www.northerndynastyminerals.com/pebble-project/photo-gallery/.

a current and comprehensive economic analysis for this mine scenario.

The Draft EIS for PLP's proposed mine-development plan for the Pebble deposit was released in February 2019; it was produced by USACE with input from a range of cooperating agencies. The subsequent 120-day comment period resulted in numerous public comments and additional agency input, all of which were then considered as part of the USACE review. In January 2020, the PLP submitted to USACE a draft Compensatory Mitigation Plan (CMP) for wetlands impacts associated with its mine development plan.

USACE published the Final EIS on July 24, 2020, in which they selected the "least environmentally damaging practicable alternative," the all-land-based transportation route to connect the proposed mine site to a port site on Cook Inlet via an approximately 85-mile-long road north of Lake Iliamna. USACE published its final mitigation requirements for the project's wetlands impacts on August 20, 2020, now requiring that mitigations be in-kind and in-watershed. In an attempt to meet these requirements, PLP proposed the creation of an 112,445-acre Koktuli Conservation Area on State-owned lands west of the project site. On November 25, USACE denied PLP's Clean Water Act Section 404 permit, stating that the CMP was not adequate to compensate for the expected impacts of the project, and that the project was not in the public interest. PLP appealed this decision in January of 2021.

Groundhog

The Groundhog prospect, explored by Quaterra Resources Inc. and Chuchuna Minerals Company, is a copper–gold porphyry exploration project lying 190 miles southwest of Anchorage and 14 miles north of the Pebble deposit. During 2020 the project's operators analyzed geophysical data collected in 2019 and compiled an NI 43-101 technical report on the property.

Terra

WestMountain Gold Inc. paused exploration at its structurally controlled, high-grade Terra gold vein system in the western Alaska Range. The project hosts an estimated 420,000 ounces of gold at an average grade of 0.446 ounce of gold per ton (appendix D).

Estelle

Nova Minerals Ltd. continued its aggressive exploration of the Estelle gold project in the western Alaska Range, approximately 110 miles northwest of Anchorage. The project's rapidly growing resource, the Korbel Main-area deposit, is a near-surface, reduced-intrusion-related gold system with gold-bearing quartz–arsenopyrite veins.

The company conducted core and RC drilling on Block A and the Block B "starter pit" of the Korbel Main deposit, as well as at nearby Blocks C and D, South East extension, and Isabella (photo 13). The 115,000-foot drill program began in February 2020 and continued through year-end. Drill intercept highlights include KBDH-003: 791.6 feet grading 0.012 ounce of gold per ton; and, KBDH-004: 1,694.9 feet grading 0.009 ounce of gold per ton; both with included higher-grade intervals. At year-end, the Korbel Main resource area extended about 5,900 feet northwest–southeast from the South East extension to the Isabella Block, and to depths of 1,640 feet.

Nova Minerals conducted surface exploration elsewhere in the Estelle claim block. Reconnaissance rock chip sampling of quartz–arsenopyrite veins at the Cathedral prospect returned up to 3.648 ounces of gold per ton, including six samples greater than 0.32 ounce of gold per ton. Reconnaissance mapping and sampling was conducted on the RPM target. Sampling focused on quartz–tourmaline–arsenopyrite stockwork and sheeted vein sets contained in felsic intrusive outcrops and returned gold values up to 3.296 and 9.312 ounces of gold per ton.

In April, AIDEA approved a resolution authorizing an agreement with Nova Minerals to advance a proposed West Susitna Access Road as part of its Roads to Resources initiative. Under the initiative, Nova Minerals and

Photo 13. Drill on-site at Nova Minerals Ltd.'s Estelle gold project in the western Alaska Range. Last accessed December 6, 2021; novaminerals.com.au/estelle-gold/.

AIDEA, together with the Matanuska-Susitna Borough, will work collaboratively to investigate the viability of permitting and constructing an all-season industrial direct-access road to the Estelle project area.

In October, Nova Minerals announced an "interim" JORC-compliant inferred mineral resource of 320 million tons averaging 0.010 ounce of gold per ton, a total of 3.3 million contained ounces of gold (appendix D, listed as 'Korbel'). This resource captures drilling through June 30, 2020.

In December, Nova Minerals announced results of their Phase I ore-sorting study. Bulk ore sorting demonstrated a 25-percent upgrade of 0.008 ounce of gold per ton feed grade. Combined, bulk and particle ore sorting systems generated a feed with an average grade of 0.192 ounce of gold per ton. In a future mine scenario, this high-grade stream would be directed to a conventional carbon-in-leach or carbon-in-pulp plant, with the remaining lower-grade material directed to a heap leach pad for gold extraction.

In the last half of the year, Nova Minerals commenced Phase II metallurgical work and a PEA study, hired environmental and permitting consultants, and initiated environmental baseline studies.

Nyac

The Nyac Mining District, which lies approximately 60 miles northeast of Bethel, includes an active placer mining operation and several lode gold prospects. Landowner Calista Corp. continued to explore for lode gold in 2020; work was carried out by shareholders from the local community and consisted of prospecting, geological mapping, and rock and soil sampling. Two new prospects were identified (photo 14).

Photo 14. A Calista Corp. exploration crew stands at the site of the Rex lode gold discovery, or "Mike's Zone." The Shamrock placer pit, which produced 50,000 oz of placer gold and the largest gold nugget found in the Nyac Mining District, is visible in the background. Photo courtesy of Varina Zinno, Calista Corp.

Southeastern Region

Greens Creek

At the operating Greens Creek silver–gold–zinc–lead mine southwest of Juneau, exploration by Hecla Mining Company continues to ensure reserves at least 10 years ahead of current mining. At year-end 2020, Greens Creek had approximately 11 years of production in its mine plan. See appendix D for detailed reserves and resources.

Stringent site-access restrictions imposed during the COVID-19 pandemic limited the amount of exploration and definition drilling that took place during 2020. Definition drilling focused on upgrading resources in the 200 South, East Ore, Southwest, 9a, and Upper Plate zones. Underground exploration identified mineralization along trend of the 200 South zone, confirming continuity between previous drill intercepts and extending known mineralization to the south.

Kensington

The Kensington gold mine lies 43 miles northwest of Juneau and is owned and operated by Coeur Alaska Inc. The mine celebrated its first decade of production in 2020, and its current reserves and resources (1.6 million ounces of gold total) will represent the next decade of production once fully proved up (appendix D). Coeur spent $8.6 million on exploration during 2020, drilling step-out targets with two surface-based drill rigs, while two underground core drill rigs focused on resource expansion and conversion in the new Elmira vein development (photo 15).

Exploration drilling was successful in expanding the Eureka, Elmira, Johnson, Raven, and Upper Kensington veins; all are located near existing underground infrastructure and represent potential resource growth areas in the next few years. Intercept highlights include 16.8 feet grading 0.98 ounce of gold per ton at Eureka, 1.1 feet of 5.45 ounces of gold per ton at Elmira, and 19.4 feet of 0.24 ounce of gold per ton in the Northern Belle structure. End-of-year reserves stood at 331,000 ounces of gold, plus 830,000 ounces of gold measured and indicated, and 394,000 ounces of gold inferred.

Palmer project

The Palmer VMS project near Haines is being explored by partners Constantine Metal Resources Ltd. (operator; 51 percent interest) and Dowa Metals & Mining Alaska Ltd. (49 percent interest). Palmer is an advanced-exploration-stage, zinc–copper–silver–gold–barite deposit with 15.7 million tons of mineralization defined to date; it occurs in the same belt of rocks that hosts Greens Creek mine, one of the world's richest VMS deposits. A 2019 PEA based on a 3,800 tons-per-day, 11-year mining and processing scenario indicated pre-production capital costs of $278 million, a pre-tax net present value of $354 million, and a post-tax payback period of 3.3 years. See appendix D for mineral resource details.

Constantine conducted a late-season, surface-based geological program at the Palmer project in 2020. Environmental baseline studies and monitoring continued, and the company continued to work with the Alaska Department of Environmental Conservation to permit an exploration drift accessing the deposit underground. The waste management permit for this project had been delayed while the U.S. Supreme Court considered the case *County of Maui, Hawaii v. Hawaii Wildlife Fund*. The Supreme Court issued its opinion in April 2020, and the U.S. Environmental Protection Agency has provided updated guidance on complying with the Court's interpretation of the Clean Water Act.

Additionally, Constantine explored its 100-percent-owned Big Nugget Gold project, located five miles east of the Palmer project. The company identified Big Nugget Gold as a potential lode gold source area immediately upstream from the Porcupine gold placer operations, which have historical production of more than 80,000 ounces. Summer fieldwork included prospecting, soil sampling, trenching, and re-sampling high-grade gold prospects evaluated by the U.S. Bureau of Mines in the mid-1980s. Structures, stratigraphic setting, and the distribution of altered mafic dikes all appear to control gold mineralization.

Bokan Mountain

Ucore Rare Metals Inc.'s Bokan Mountain property 35 miles southwest of Ketchikan hosts Alaska's only defined resource of rare earth elements (REE); it is particularly rich in the

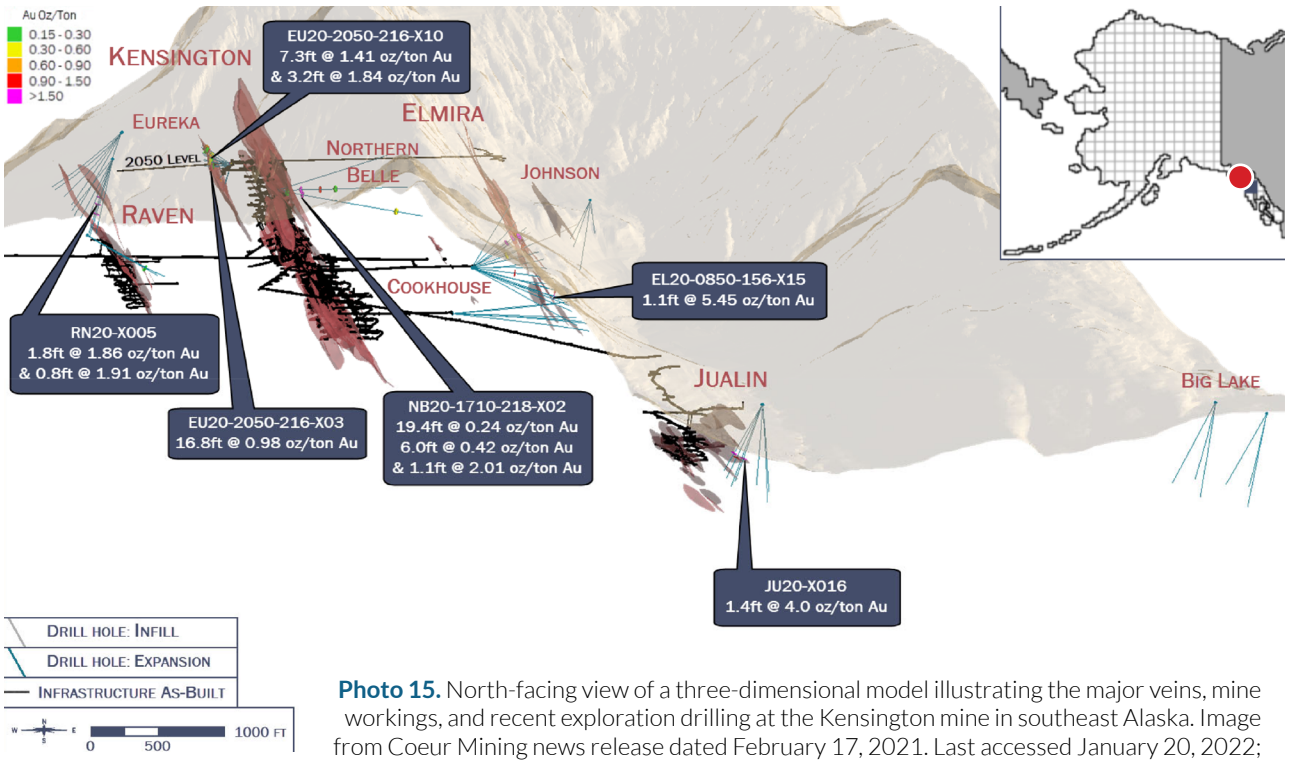


Photo 15. North-facing view of a three-dimensional model illustrating the major veins, mine workings, and recent exploration drilling at the Kensington mine in southeast Alaska. Image from Coeur Mining news release dated February 17, 2021. Last accessed January 20, 2022; www.coeur.com/_resources/news/nr_20210217.pdf.

more valuable and strategically important heavy REE (see appendix D for resource details). The company completed a PEA in 2013 and secured the promise of long-term low interest financing through AIDEA.

In February 2020, Ucore engaged SGS Canada Inc. to advance the design of a prospective first-stage mineral processing plant, involving lab-scale optimization of the mineral-processing flowsheet for the Bokan-site mill. The revised flowsheet is expected to optimize the beneficiation of REE and consider the incorporation of co-product critical metals niobium, zirconium, beryllium, hafnium, titanium, and vanadium, which had not been included as part of the recovery in previous studies.

In May, Ucore purchased Innovation Metals Corp. (IMC). IMC developed and owns technology ("RapidSX™") for the separation and purification of critical metals, including REE. RapidSX™ is an accelerated solvent-extraction-based separation technology that has proven effective at the pilot scale in separating both heavy and light REE feedstocks to commercial-grade REE oxides. RapidSX™ combines the chemistry of solvent extraction (SX) technology (the REE industry's current standard bulk commercial separation technology) with a new column-based platform.

In October, Ucore shipped more than 1.65 tons of REE feedstock material produced from the Bokan–Dotson Ridge site to IMC's facility in Kingston, Ontario, Canada. The material will be used to produce a purified REE concentrate that will then be transformed into high-purity REE oxides via the RapidSX™ separation technology to demonstrate the suitability of the Bokan material for producing commercial-quality REE oxides.

In August, the U.S. Forest Service (USFS) reached an agreement with Newmont USA Limited and Dawn Mining Company to finance the environmental renewal of the former Ross Adams uranium mine site at Bokan Mountain. The project will include the consolidation of mine rock and any remaining previously mined uranium-laden material from the Ross Adams site (and secondary transit areas) and place those materials in an on-site repository at the mine's open-pit location. The repository for the hazardous materials will be covered with clean soil and engineered to protect human health and the environment. Additionally, non-hazardous remnants of the former mining operation will be removed. As part of the agreement, the USFS concluded a 30-day public comment period as of August 7, 2020, and may withdraw or withhold its consent to the project based on the review of public feedback. Otherwise, cleanup activities are expected to move forward later in the year, administered by the USFS. This project will set a clean slate for Ucore's permitting and planned future mining at the Bokan–Dotson Ridge REE project.

Herbert Gold

Grande Portage Resources, Ltd. staged an exploration drill program at its Herbert Gold project, a vein-hosted orogenic system that is part of the Juneau Gold Belt. The Juneau Gold Belt also includes the active Kensington mine and the historically productive Alaska-Juneau mine. In 2020 Grande Portage drilled 21 holes with two drill rigs for a total of 27,477 feet. Drilling expanded mineralization eastward at the Goat, Main, and Deep Trench veins and tested the system down-dip with some of the deepest holes drilled on the property to date. Drill intercept highlights include 3.31 ounces of gold per ton over 3.9 feet at the Goat vein, 0.85 ounce of gold per ton over 4.8 feet at the Ridge Vein, 0.55 ounce of gold per ton over 8.6 feet at the Main Vein, and 0.34 ounce of gold per ton over 14.8 feet at the Deep Trench vein.

The company updated its mineral resource estimate for the project in early 2021. With nine veins contributing, the project now hosts 1.5 million ounces of gold at an average grade of 0.29 ounce of gold per ton (indicated plus inferred; appendix D).

Helm Bay

Helm Bay is a historical gold mining area located on the Cleveland Peninsula about 25 miles north of Ketchikan. Surface exploration activities at Agnico Eagle (USA) Ltd.'s Helm Bay project included geologic mapping, geochemical sampling of bedrock, and drill hole planning (photo 16). Permitting activities, including a sensitive plant survey and archeological surveys, were completed in 2020 and drilling permits were approved.

Niblack

Niblack is an advanced-exploration-stage copper–gold–zinc–silver project on Prince of Wales Island, approximately 27 miles southwest of Ketchikan. The property hosts six known zones of VMS mineralization, including the Lookout and Trio deposits, which host a combined total of almost 10 million tons of mineralization grading 0.8 percent copper, 1.3 percent zinc, 0.04 ounce of gold per ton, and 0.59 ounce of silver per ton (appendix D). The property is owned and explored by Blackwolf Copper and Gold Ltd. (formerly Heatherdale Resources Ltd.).

Blackwolf Copper and Gold Ltd. appointed veteran mining executive Rob McLeod as CEO and resumed exploration of the property in 2020 following an eight-year hiatus in drilling. The company completed ten diamond drill holes totaling 5,820 feet, targeting extensions to mineralization at the historical Niblack mine. Highlights of this drilling include 36.4 feet averaging 2.33 percent copper, 0.095 ounce of gold per ton, 1.44 ounces of silver per ton, and 1.78 percent zinc; and 18.0 feet averaging 4.32 percent copper, 0.044 ounce of gold per ton, 0.986 ounce of silver per ton, and 4.43 percent zinc. Blackwolf also rehabilitated the 2,789-foot-long exploration drift to facilitate future planned underground drilling.

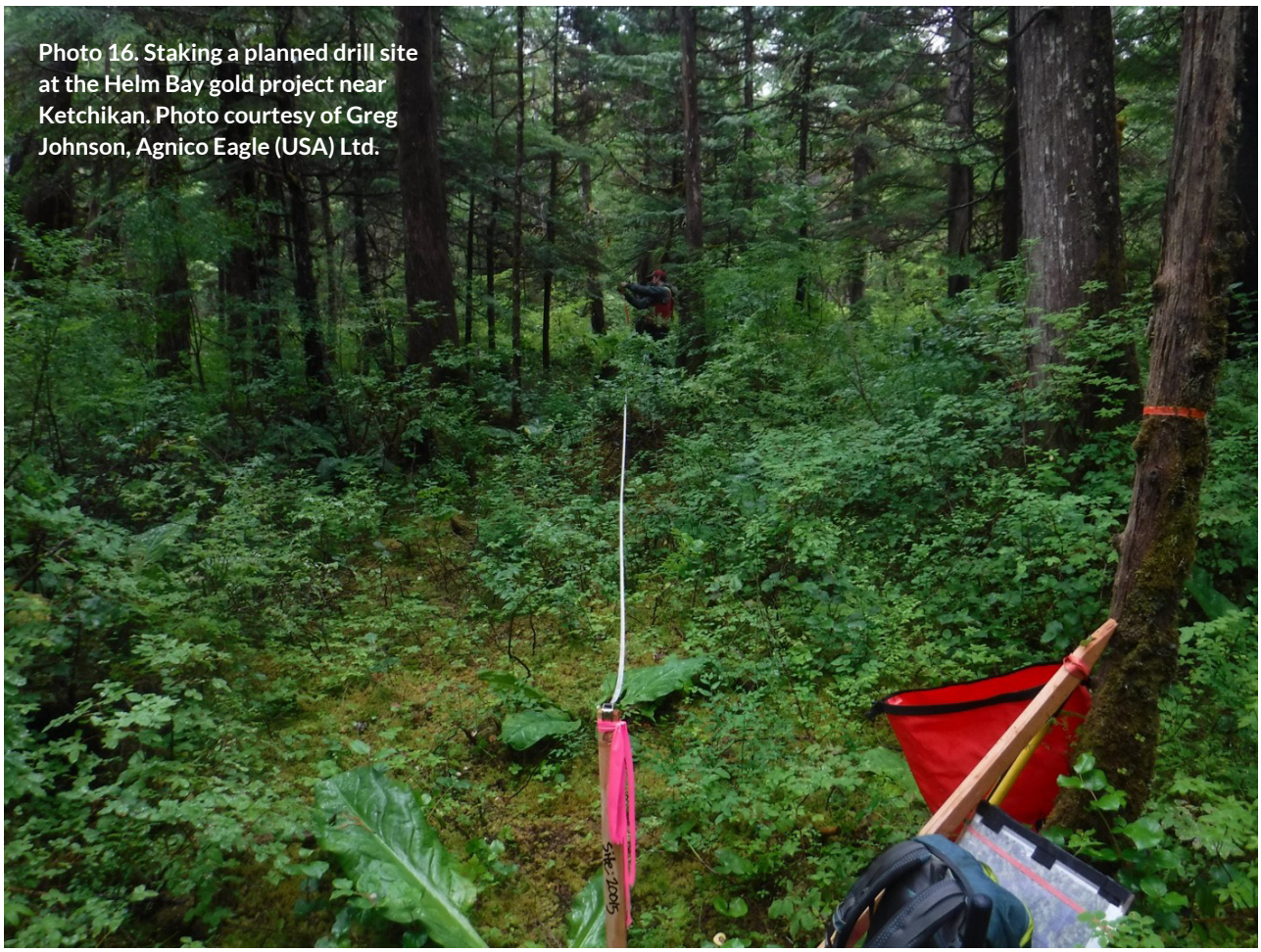


Photo 16. Staking a planned drill site at the Helm Bay gold project near Ketchikan. Photo courtesy of Greg Johnson, Agnico Eagle (USA) Ltd.

Alaska Peninsula Region

Unga Project

Heliostar Metals Ltd. (formerly Redstar Gold Corp.) mounted an expanded exploration drill program at its Unga epithermal gold–silver project in 2020. The project includes the past-producing Apollo–Sitka mine and the Shumagin, Centennial, and Aquila prospects on Unga and Popof islands. The Apollo mine was Alaska's first underground gold mine, producing an estimated 130,000 ounces prior to its closure in 1922.

In early 2020, the company announced the project's first NI 43-101-compliant mineral resource, an inferred estimate of the SH-1 vein, totaling 384,300 ounces of gold at an average grade of 0.40 ounce of gold per ton, and 986,300 ounces of silver at a grade of 1.03 ounces of silver per ton (appendix D).

The 2020 drill program was challenged by contractor staffing issues, and the 10,400 feet drilled by season-end in late November was less than half the originally planned program (photo 17). Drilling at SH-1 was designed to expand the resource; resulting highlights include 0.470 ounce of gold per ton over 13.1 feet and 0.243 ounce of gold per ton over 18.1 feet. Drilling at the Apollo–Sitka mine yielded a highlight intercept of 0.149 ounce of gold per ton over 6.5 feet. Following up on geological targeting at the Aquila, Empire Ridge, and other prospects, exploration drilling at Aquila resulted in intercepts of 0.130 ounce of gold per ton over 11.8 feet and 0.162 ounce of gold per ton over 18.9 feet.

Photo 17. Fall core drilling at the Aquila epithermal gold prospect on Unga Island near the Alaska Peninsula. Photo courtesy of Stewart Harris, Heliostar Metals Ltd.

DEVELOPMENT AND PRODUCTION

Alaska's metal mines benefited from rising gold and silver prices during 2020, offset by declining zinc and lead prices, resulting in a ten percent year-over-year increase in the total revenue realized by Alaska producers ($2.8 billion; table 1). Coal production held steady. Development spending fell by 23 percent to $267.8 million in 2020, as the Red Dog mine announced completion of a major, multi-year mill upgrade project (table 8). Seven projects reported development expenditures; the bulk of development was conducted by Alaska's operating mines (fig. 6). Expenditures of permitting-stage projects are tabulated in the exploration section of this report.

Gold and silver prices continued to shine in 2020, both up 27 percent from the prior year to average 2020 prices of $1,770.00 and $20.55 per ounce, respectively. The price of zinc slumped 13 percent to an average of $1.01 per pound in 2020, while the price of lead fell 10 percent to average $0.82 per pound (table 9).

Variability in commodity prices and production volumes led to mixed 2020 outcomes for company revenues and estimated production values for commodities. On the positive side, the value of gold production increased 38 percent on an 11 percent increase in production coupled with record-high gold prices. Declines in the price and production of zinc combined for a 22 percent decrease in its revenue (table 10).

Zinc remains the State's leading mineral product by a slim margin, having a reported production value of $1.16 billion in 2020. Zinc accounted for 42 percent of Alaska's metal production value, while gold—which benefited from rising prices and rebounding production—accounted for 40 percent (fig. 7). The annual value of zinc production has exceeded that of gold since 2014 (appendix B). Production of lead and silver was essentially unchanged in 2020, but the value of Alaska's lead production decreased 15 percent on falling prices (table 10).

Production & Development

I. Northern Region

1 Red Dog Mine—Teck Alaska Inc.

II. Western Region

2. Nixon Fork—Mystery Creek Resources Inc.*

III. Eastern Interior Region

3. Fort Knox Mine—Fairbanks Gold Mining Inc.
4. Pogo—Northern Star Resources Ltd.
5. Usibelli Coal Mine—Usibelli Coal Mine Inc.

IV. South-central Region

V. Southwestern Region

6. Donlin Gold project—Donlin Gold LLC*

VI. Alaska Peninsula Region

VII. Southeastern Region

7. Kensington—Coeur Alaska Inc.
8. Greens Creek Mine—Hecla Mining Company
9. Dawson Mine—Sundance Mining Group LLC
10. Calder Mine—Columbia River Carbonates

** Development activity only*

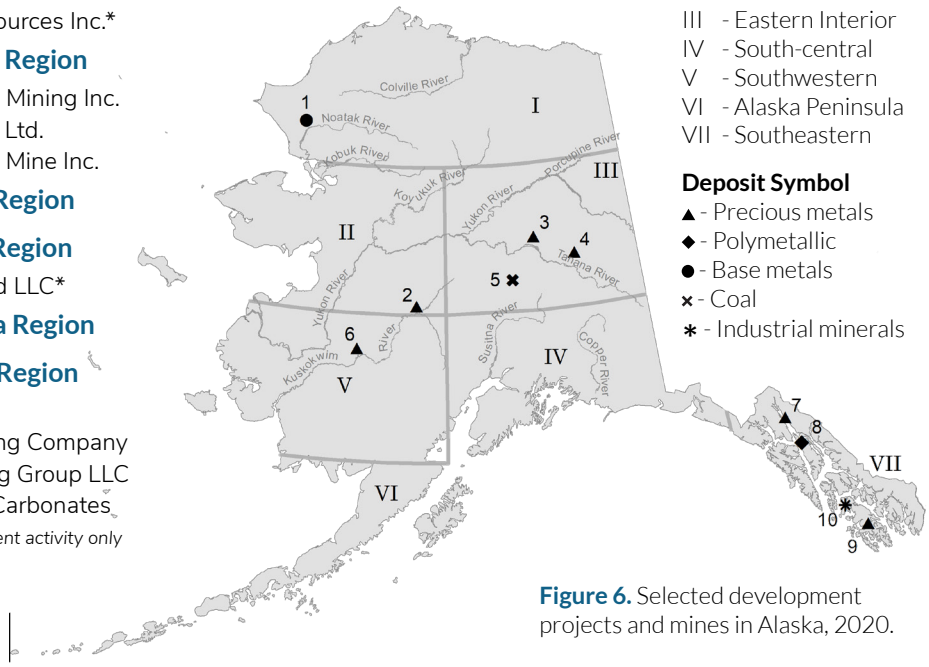


Figure 6. Selected development projects and mines in Alaska, 2020.

Table 8. Reported mineral development expenditures in Alaska by commodity, 1982–2020.

Year	Base Metals	Polymetallics[a]	Precious Metals	Gemstones[b]	Industrial Minerals	Coal and Peat	Total
1982	$ 10,270,000		$ 19,320,000		$ 4,251,000	$ 7,750,000	$ 41,591,000
1983	19,500,000		7,112,500		1,000,000	250,000	27,862,500
1984	10,710,500		15,058,555		579,000	27,000,000	53,348,055
1985	13,000,000		16,890,755		1,830,000	2,400,000	34,120,755
1986[a]	3,260,800	$ 8,000,000	12,417,172		124,000	530,000	24,331,972
1987	38,080,000	48,000,000	13,640,848		188,000	342,000	100,250,848
1988	165,500,000	69,000,000	40,445,400		–	–	274,945,400
1989	118,200,000	411,000	6,465,350		7,000,000	2,196,000	134,272,350
1990	–	4,101,000	7,136,500		30,000	3,079,000	14,346,500
1991	–	8,000,000	14,994,350		262,000	2,318,000	25,574,350
1992	80,000	4,300,000	23,151,300		404,000	1,655,000	29,590,300
1993	–	10,731,136	15,103,000		433,500	1,400,000	27,667,636
1994	10,000,000	5,000,000	27,392,850		5,000	2,545,000	44,942,850
1995	11,200,000	9,590,000	127,165,750		426,000	200,000	148,581,750
1996	60,000,000	60,100,000	273,042,000		495,000	400,000	394,037,000
1997	133,880,000	7,300,000	26,299,000		500,000	410,000	168,389,000
1998	28,000,000	5,600,000	15,602,000		5,355,000	850,000	55,407,000
1999	12,500,000	2,500,000	15,864,000		400,000	2,575,000	33,839,000
2000	100,000,000	16,400,000	24,699,000		611,000	–	141,710,000
2001	43,800,000	3,300,000	32,719,000		300,000	1,040,000	81,159,000
2002	–	5,700,000	26,655,000		250,000	1,450,000	34,055,000
2003	–	–	38,839,332		315,000	–	39,154,332
2004	17,700,000	6,215,000	177,440,081		4,991,434	2,760,000	209,106,515
2005	28,000,000	16,700,000	301,011,469		856,500	1,350,000	347,917,969
2006	31,200,000	26,183,280	420,759,203		1,566,000	15,985,000	495,693,483
2007	41,374,880	30,766,902	239,931,040		1,320,500	5,385,000	318,778,322
2008	45,000,000	24,000,000	319,702,594		205,113	7,260,000	396,167,707
2009[b]	29,000,000	17,500,000	277,020,142	$ 225,250	270,000	6,800,000	330,815,392
2010	42,000,000	16,300,000	225,793,300	200,000	–	9,000,000	293,293,300
2011	48,590,865	41,657,000	170,931,851	250,000	902,480	9,560,000	271,892,196
2012	35,234,500	62,184,000	235,642,406	–	5,290,870	4,021,544	342,373,320
2013	W	57,119,121	258,130,353	295,000	1,831,369	W	358,775,844
2014	W	W	199,909,824	700,000	756,495	–	281,735,787
2015[c]	W	W	188,226,940	–	–	–	309,938,884
2016	W	47,046,279	133,243,900	–	–	W	217,376,728
2017	W	35,254,986	209,082,444	–	–	W	299,502,316
2018	W	46,863,810	156,263,106	–	–	W	334,112,057
2019	W	35,830,809	184,097,276	–	–	W	347,822,085
2020	W	28,797,676	192,624,758	–	–	W	267,765,434
Total	**$ 1,096,081,545**	**$ 760,451,999**	**$ 4,689,824,349**	**$ 1,670,250**	**$ 42,749,261**	**$ 120,511,544**	**$ 7,352,243,937**

[a]Polymetallics category added in 1986.

[b]Gemstone development category added in 2009.

[c]Significant development expenditures were not reported for precious metals in 2015.

– = Not reported

W = Figures withheld for confidentiality purposes. Expenditures are incorporated into the State total.

Table 9. Average metal prices, 1996–2020.

Year	Gold $/oz	Silver $/oz	Copper $/lb	Lead $/lb	Zinc $/lb
1996	387.60	5.19	1.03	0.37	0.49
1997	330.76	4.91	1.03	0.28	0.59
1998	293.88	5.53	0.75	0.24	0.46
1999	278.70	5.20	0.71	0.23	0.49
2000	279.10	4.96	0.82	0.21	0.51
2001	271.04	4.37	0.71	0.22	0.40
2002	310.06	4.61	0.41	0.21	0.35
2003	363.38	4.88	0.81	0.23	0.38
2004	409.72	6.67	1.29	0.40	0.47
2005	444.74	7.32	1.61	0.43	0.63
2006	603.46	11.55	3.02	0.58	1.47
2007	695.39	13.38	3.24	1.17	1.47
2008	871.96	14.99	3.12	0.94	0.84
2009[a]	972.35	14.67	2.35	0.78	0.75
2010[a]	1,224.53	20.19	3.42	0.97	0.98
2011[a]	1,571.52	35.12	3.99	1.09	0.99
2012[a]	1,668.98	31.15	3.61	0.93	0.88
2013[a,b]	1,411.23	23.79	3.32	0.97	0.87
2014[a,b]	1,266.40	19.78	3.11	0.95	0.98
2015[a,b]	1,160.06	15.68	2.50	0.81	0.88
2016[a,b]	1,250.74	17.14	2.21	0.85	0.95
2017[a,b]	1,257.12	17.04	2.80	1.05	1.31
2018[a,b]	1,268.49	15.71	2.96	1.02	1.33
2019[a,b]	1,392.60	16.21	2.72	0.91	1.16
2020[a,b]	1,769.64	20.55	2.70	0.82	1.01

The figures in this table will change as data are reviewed and updated.

[a]2009–2020 gold and silver prices from Kitco cumulative average London PM fix; 2009–2012 copper, lead, and zinc from British Columbia Ministry of Energy and Mines.

[b]2013–2020 copper, lead, and zinc prices from U.S. Geological Survey Mineral Commodity Summaries, based on London Metal Exchange (LME), and LME average daily settlement.

Gold production from lode mines in the Eastern Interior and Southeastern regions totaled 618,918 ounces in 2020, of which two-thirds was produced from the Fort Knox and Pogo gold mines in the Eastern Interior region (fig. 8). Kensington gold and Greens Creek polymetallic mines in southeastern Alaska, the third and fourth largest gold producers, along with the Dawson mine accounted for the remainder of lode gold production. Placer gold production in 2020 is estimated at 32,501 ounces (table 11). Employment related to gold production in 2020 is 1,143 full-time-equivalent jobs; more than 35 percent of mining jobs in all sectors (table 2).

The value of Alaska industrial minerals (rock, sand, and gravel) is at least $5.7 million in 2020. This figure is based on reported production from State lands, BLM, and the U.S. Forest Service; it does not include Mental Health Trust lands or lands managed by the State Pipeline Coordinator's Office (fig. 9; appendix C). The total estimated volume of industrial minerals sold in the State is 2.1 million tons. This figure includes data from all three DNR land offices (table 12), of which the Northern region accounted for 89 percent of production from State lands. The 2020 production volume, value, and employment figures should be considered minimum estimates due to reporting shortfalls. These figures do not account for significant production of industrial minerals on private, Native, and other Federal lands.

The 2020 export value was $1.7 billion for ores, concentrates, and other mining products shipped from Alaska, down 10 percent from 2019 (table 13). Total exports include copper–gold concentrates from the Minto Mine in Yukon, Canada, that were shipped through the AIDEA-owned terminal in Skagway. Usibelli Coal Mine did not export coal outside of Alaska in 2020 (fig. 10). Alaska exported ores, concentrates, and other mining products worth $1.36 billion to Asia, Europe, North America, and Australia and Oceania in 2020. Canada received 27 percent of concentrates, followed by South Korea (18 percent), Japan (16 percent), China (12 percent); Germany, Belgium, the Netherlands, Finland, and Italy combined received 16 percent of Alaska's metal ore exports.[7]

Development and production estimates in this report are compiled from a variety of

[7]USA Trade Online, U.S. Census Bureau, last accessed November 24, 2021. usatrade.census.gov/

Table 10. Estimated mineral production in Alaska, 2018–2020.[a,b]

	Production Volume			Production value ($)		
Metals	**2018**	**2019**	**2020**	**2018**	**2019**	**2020**
Gold (ounces)	711,986	589,080	651,418	$ 888,302,130	$ 802,502,161	$ 1,105,445,191
Silver (ounces)	15,116,355	17,674,583	17,997,209	210,826,760	258,052,067	321,364,224
Lead (tons)	127,427	133,424	128,875	252,176,360	233,202,741	199,206,769
Zinc (tons)	698,218	665,889	597,718	1,851,779,320	1,486,128,992	1,164,745,504
Subtotal				**$ 3,203,084,570**	**$ 2,779,885,961**	**$ 2,790,761,688**
Industrial Minerals						
Sand and gravel (million tons)[c]	4.0	2.7	2.1	$ 10,531,812	$ 7,768,680	$ 5,742,958
Rock (million tons)	–	–	–	–	–	–
Subtotal				**$ 10,531,812**	**$ 7,768,680**	**$ 5,742,958**
Coal and Peat						
Coal (tons)[d]	1,000,000	1,000,000	1,020,870	$ 35,000,000	$ 35,000,000	$ 51,043,500
Peat (cubic yards)	–	–	–	–	–	–
Subtotal				**$ 35,000,000**	**$ 35,000,000**	**$ 51,043,500**
Total				**$ 3,248,616,382**	**$ 2,822,654,641**	**$ 2,847,548,147**

[a] Production data from DGGS questionnaires, Internet research, interviews with operators, DOT&PF, and municipalities, regional corporations, and Federal land management agencies.

[b] Values for selected metals, coal, and industrial minerals production are based on average prices for each year unless public values were provided by the operator. Total value does not match the Mining Revenue in table 1 due to the incorporation of confidential data in the statewide total.

[c] Industrial minerals (rock, sand, and gravel) values are combined into the sand and gravel category in 2018–2020.

[d] Coal price assumption for revenue was updated from $35 to $50 per ton starting in 2020. This estimate is based on a coal price of $3.37 per million BTU published for Alaska by the U.S. Energy Information Administration (https://www.eia.gov/state/print.php?sid=AK; last accessed November 15, 2021) and a heat value of 7,560 BTU per pound reported by Usibelli (http://www.usibelli.com/coal/data-sheet, last accessed January 13, 2022). 2020 coal production for Usibelli Coal Mine was reported by MSHA (https://arlweb.msha.gov/OpenGovernmentData/DataSets/MinesProdYearly.zip).

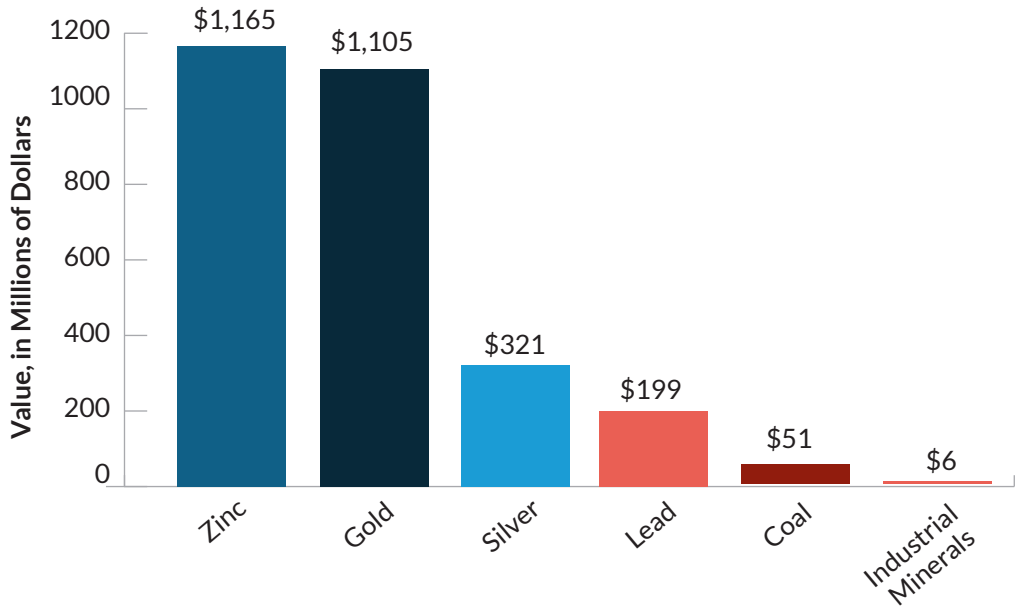


Figure 7. Estimated 2020 mineral production in Alaska by commodity.

Figure 8.
Historical gold production in Alaska, 1880–2020, and corresponding market value.

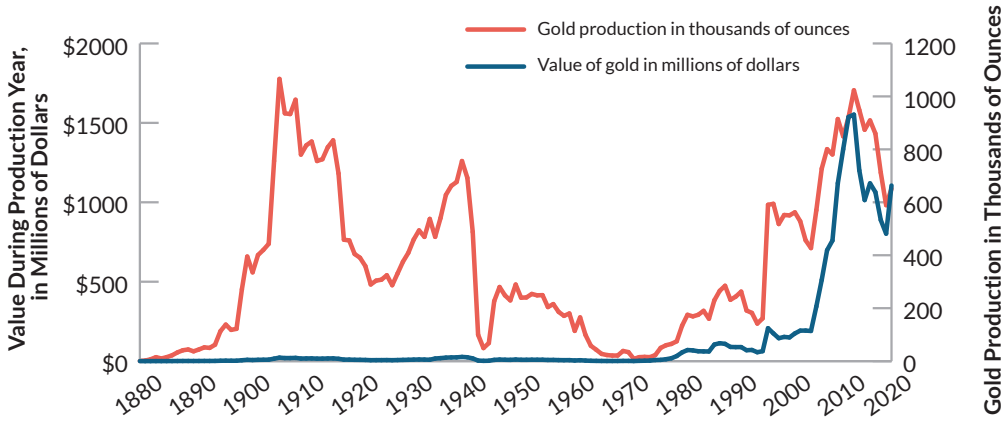


Table 11. Production and employment estimates for Alaska placer gold mines, 2014–2020. Values for 2020 (italics) are estimated based on reported placer data for 2019. Prior-year data are not updated in this table to maintain consistency with calculations and other tables in this report.[a]

	2014	2015	2016	2017	2018	2019	2020 estimate
Number of placer operations reporting gross operating income[a]	238	236	205	192	169	150	*150*
Total gross operating income reported[a]	$ 78,200,155	$ 64,803,637	$ 51,912,476	$ 76,985,791	$ 66,845,710	$ 57,514,359	*$ 57,514,359*
Average yearly price of gold[b]	$ 1,266.40	$ 1,160.06	$ 1,250.74	$ 1,257.12	$ 1,268.49	$ 1,392.60	*$ 1,769.64*
Estimated number of gold ounces produced	61,750	55,862	41,505	61,240	52,697	41,300	*32,501*
Estimated number of full-time-equivalent employees	224	222	193	181	159	141	*141*

Estimated number of gold ounces produced is calculated by dividing the total gross income by the average price of gold. This yearly estimate does not take into account gold stockpiled, sold in other years, or paid as wages.

Estimated number of employees is calculated by multiplying the number of placer operations by 4 workers per mine, a factor determined for the October 2014 report ***The Economic Impacts of Placer Mining in Alaska*** prepared by McDowell Group, https://www.dropbox.com/s/wly4yrnmlop59on/AMA%20Placer%20Final%20Report%2011.15.pdf?dl=0. The factor takes in account unpaid family members and workers paid directly in gold. Full-time-equivalent jobs were calculated by multiplying the total number of workers by a ratio of 86 placer miner working-days per year/365 days. The number of placer miner working-days per year was determined by McDowell Group for the October 2014 report.

[a]Values provided by the Department of Revenue. Updated figures for prior years include: in TY 2014, 227 operations reported income of $77,560,874; in TY 2015, 220 operations reported income of $63,607,692; in TY 2016, 203 operations reported income of $53,137,504; in TY 2017, 196 operations reported income of $77,286,581; and in TY 2018, 168 operations reported income of $66,808,408.

[b]2013–2020 gold prices from Kitco cumulative average London PM fix.

online sources: annual reports, company financial reports (10-K, etc.), and news releases by companies. They are supplemented by questionnaires returned to DGGS by mining companies, as well as personal communications such as phone calls and emails.

Over the last 10 years, the majority of development work has been conducted at mine sites, with development activities being integral to the mining operations. Additionally, there have been few purely development-stage projects. The development sector of the mining process refers to building infrastructure or conducting activities that facilitate production of mineral products. Development expenditures reflect actual expenditures at mines as well as sustaining capital. Sustaining capital includes equipment replacement and rebuilding, facility upgrades, and other expenditures that must be amortized or depreciated in accordance with tax laws; and thus are frequently reported as distinct line items in securities filings. Development activities, whether

to build a new mine or make improvements to an existing mine, are often precursors to increased annual production or extended mine life, while production expenditures include those costs directly related to the production of metals.

Average metal prices used in this report are based on the average daily London Metal Exchange (LME) price (table 9). Some respondents reported actual unit values received for production; in cases where actual values were available, they were used in place of the average values. This report uses revenue as reported by producers to quantify production values. If unavailable or confidential, the theoretical first market value (estimated gross value of a pure mineral product at first wholesale) is used instead to approximate the value of production. Therefore, the theoretical first market value does not represent actual sales or gross income of producers; does not take into account shipping, smelting, refining, and other costs incurred by the producer; and may significantly overestimate the actual value of the material.

Red Dog Mine

Red Dog mine in northwestern Alaska is one of the world's largest sediment-hosted massive sulfide zinc deposits. It is operated by Teck Alaska Inc. as an open-pit, truck-and-loader operation that uses conventional drill-and-blast mining methods. On-site mineral-processing facilities employ conventional grinding and sulfide-flotation methods to produce zinc and lead concentrates, which are transported to the coast for shipment during the summer season. Teck Alaska leases the road and port facilities from AIDEA.

Red Dog mine consists of three ore bodies: Main (exhausted in early 2012), Aqqaluk (currently active), and Qanaiyaq (active; initial mining in 2017). Reserves and resources for the Aqqaluk and Qanaiyaq deposits as of year-end 2020 are tabulated in appendix D. During the first quarter of 2017, ore from the higher-grade Qanaiyaq deposit was introduced to supplement declining-grade ore from the Aqqaluk pit. Qanaiyaq ore is planned to make up about 20 percent of the mill feed through 2027.

In 2020 Red Dog zinc production decreased to 540,904 tons compared to 608,916 tons in 2019 (table 14), primarily due to lower zinc grades and lower recoveries. The zinc grade averaged 14.2 percent, with an 82.3 percent recovery rate. Lead production in 2020 fell to 107,475 tons, compared to 113,312 tons in 2019. The lead grade in 2020 averaged 4.0 percent with a 57.8 percent recovery rate. In 2020 Teck Alaska employed approximately 775 full-time staff (including contractors), mined 12,405,397 tons of material, milled 4,625,293 tons of material, and sold 1.237 billion pounds of zinc and 204.37 million pounds of lead.

Teck's gross profit from Red Dog in 2020 was $382 million, down 27 percent from $524 million in 2019; cashflow before depreciation and amortization totaled $534 million in 2020 and $631 million in 2019. Lower zinc and lead prices, higher smelter processing charges, and increased depreciation and amortization

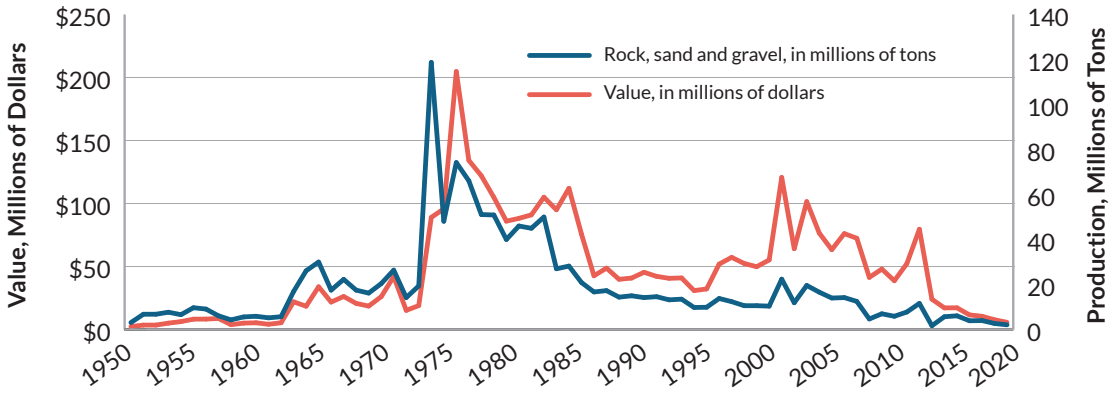


Figure 9. Rock, sand, and gravel production in Alaska, 1950–2020.

Table 12. Material (rock, sand, and gravel) sale volumes (in tons) by region reported on State-owned land, excluding Mental Health Trust lands or lands managed by the State Pipeline Coordinator's Office, for 2012–2020. These volumes do not include material produced from private, Native, or Federal lands, which are significant amounts. These figures serve as minimum amounts of material produced.

Regions	2012	2013	2014	2015	2016	2017	2018	2019	2020
Northern (Fairbanks office)	3,501,387	4,991,349	9,247,223	3,559,580	4,989,855	3,501,847	2,466,002	1,918,082	1,350,906
South-Central (Anchorage office)	1,035,450	235,050	433,433	2,115,750	396,657	396,657	143,597	529,894	163,574
Southeast (Juneau office)	56,115	69,866	62,559	50,211	13,268	13,268	30,173	32,957	3,921
Total Tons	**4,592,952**	**5,296,265**	**9,743,214**	**5,725,541**	**5,399,780**	**3,911,772**	**2,639,771**	**2,480,933**	**1,518,401**

Source: Department of Natural Resources, Division of Mining, Land and Water Southeast Regional Office (SERO), South-Central Regional Office (SCRO), and Northern Regional Office (NRO) Material Sale Tracking Spreadsheets.

DNR material sales volumes and revenues do not correlate, as volumes are attributed to the calendar year in which material was extracted while revenues are tracked on a cash basis (when received), which could be in the subsequent calendar year.

Table 13. Alaska international mineral export values (in millions of dollars).

Year	Mineral Ores and Concentrates[a]	Canada Copper Ores through Skagway Terminal[b]	Precious Metals[c]	Coal[d]	Total Value of Mineral Exports
1996	$ 249	–	> $1	$ 27	**$ 276**
1997	369	–	> $1	26	**395**
1998	317	–	> $1	8	**325**
1999	359	–	> $1	15	**374**
2000	293	–	1	16	**310**
2001	329	–	3	17	**349**
2002	380	–	47	9	**436**
2003	413	–	84	4	**501**
2004	505	–	110	14	**629**
2005	511	–	132	14	**657**
2006	1,094	–	110	10	**1,214**
2007	1,269	$ 16	132	5	**1,406**
2008	691	103	144	23	**858**
2009	853	64	153	33	**1,039**
2010	1,336	37	214	25	**1,575**
2011	1,809	199	267	31	**2,107**
2012	1,502	169	84	32	**1,618**
2013	1,495	150	22	27	**1,543**
2014	1,750	186	11	17	**1,778**
2015	1,467	99	7	5	**1,479**
2016	1,523	146	26	2	**1,551**
2017	1,794	1	13	0	**1,807**
2018	1,773	43	7	0	**1,780**
2019	1,637	33	274	0	**1,911**
2020	1,358	66	367	0	**1,725**

Sources: 1996–2013, 2018–2020, U.S. Census Bureau, Origin of Movement Series via USA Trade Online https://usatrade.census.gov/; 2014–2017, Alaska Office of International Trade

[a]HS 26 Mineral Ores: Zinc ores and concentrates, lead ores and concentrates, copper ores and concentrates, silver ores, gold ores and concentrates, zirconium ore (only in 2009), and miscellaneous ores.

[b]Value of Canada copper ores moving through Skagway that are included in Mineral Ores and Concentrates

[c]HS 71 Precious Metals: Gold doré, precious stones, and wrought jewelry

[d]HS 27 Coal

impacted profitability. Teck completed capitalized stripping worth $38.7 million and made sustaining capital investments of $19.4 million at Red Dog operations.

The Red Dog mill upgrade project, begun in 2017, was completed during 2020. The upgrade is expected to increase average mill throughput by about 15 percent over the remaining mine life, helping to offset lower grades and harder ore.

In accordance with the operating agreement between Teck and NANA Regional Corporation, Inc. (NANA) governing the Red Dog mine, Teck pays a royalty on net proceeds of production each quarter. This royalty increases by five percent every fifth year—to a maximum of 50 percent. The most recent increase occurred in October 2017, bringing the royalty to 35 percent. Teck paid $175 million in royalties to NANA in 2020; approximately 60 percent of these royalties are ultimately redistributed to other Alaska Native regional corporations.

Fort Knox Mine

The Fort Knox plutonic-hosted gold mine, located 20 miles north of Fairbanks, is operated by Fairbanks Gold Mining, Inc., a wholly owned subsidiary of Kinross Gold Corporation. The open-pit and truck-and-shovel operation uses carbon-in-pulp, heap leach, and gravity processes to recover gold. Fort Knox production for 2020 totaled 237,925 gold-equivalent ounces, a 19 percent increase over 2019, attributable to the increased volume of ore mined and processed. The mine employed an average of approximately 620 workers during the year.

In 2020 Fort Knox mined 31.5 million tons of ore, processing 10.1 million tons through the mill and placing 25.3 million tons on two heap leach pads (table 15). Mill grade averaged 0.019 ounce of gold per ton with an 81.4 percent recovery rate; the heap leach grade averaged 0.006 ounce of gold per ton. Compared to 2019, tons mined increased by 13 percent, total tons processed (including ore placed on heap leach pads) increased by 21 percent, and mill feed grade increased by 18 percent. These increases resulted from the planned mining sequence. In the fourth quarter of 2020, Kinross began placing ore on the newly constructed Barnes Creek heap leach facility (photo 18). This marks the beginning of production from the Gilmore project, a westward expansion of the Fort Knox pit encompassing more than two million ounces of gold, which was facilitated by a 2017 land exchange between the State of Alaska and the Federal Government.

Fort Knox returned to positive earnings during 2020 following negative earnings in 2018 and 2019. The mine had $422.9 million in metal sales, an increase of 51 percent attributable to higher gold prices and higher production.

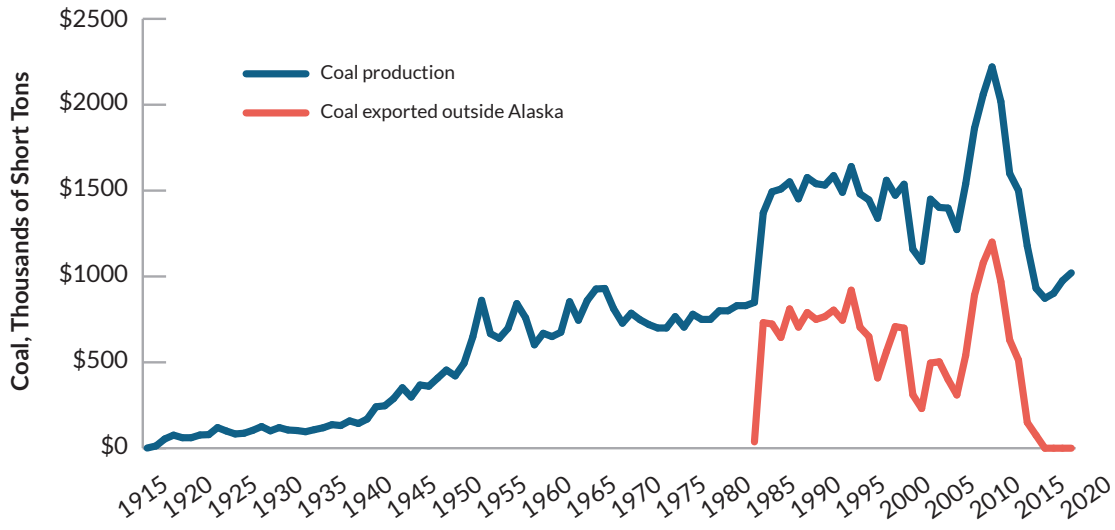


Figure 10. Alaska coal production and exports, 1915–2020.

Table 14. Red Dog mine production statistics, 1989–2020.[a]

Year	Tons Milled	Ore Grade			Total Tons Concentrate Produced[b]	Contained Tons Zinc	Contained Tons Lead	Million Ounces Silver[c]	Employees[d]
		Zinc (%)	Lead (%)	Silver (oz/ton)					
1989	33,300	20.4	7.6	3.6	8,532	–	–	–	228
1990	996,700	26.5	8.5	3.6	443,600	191,981	31,187	1.6	350
1991	1,599,300	22.5	6.6	2.8	521,400	234,510	43,815	1.46	331
1992	1,582,000	19.9	6.0	2.9	474,900	231,363	15,960	1.38	349
1993	1,874,600	18.4	5.7	2.8	539,800	255,149	24,788	1.51	376
1994	2,339,500	18.8	5.7	2.8	658,000	328,160	32,775	1.84	391
1995	2,485,900	19.0	5.8	2.8	753,600	358,676	55,715	3.62	397
1996	2,312,600	18.7	5.0	2.8	765,300	357,680	65,886	4.3	417
1997	2,127,000	20.3	5.2	2.9	799,400	373,097	69,284	4.27	479
1998	2,752,587	21.4	5.2	2.7	1,015,773	490,461	80,193	5.2	466
1999	3,282,788	21.3	5.2	2.7	1,207,160	574,111	97,756	6.21	539
2000	3,365,508	21.0	4.7	2.5	1,211,539	585,030	91,557	5.84	536
2001	3,560,430	19.8	5.0	2.5	1,215,837	570,980	105,000	5.9	559
2002	3,489,600	21.1	5.4	2.7	1,366,480	637,800	118,880	6.75	560
2003	3,476,689	21.7	6.2	3.1	1,410,892	638,569	137,679	7.7	388
2004	3,249,613	22.0	6.0	3.0	1,337,545	610,900	128,970	7.22	508
2005	3,402,831	21.7	5.6	3.0	1,330,717	626,112	112,766	1.97	449
2006	3,569,280	20.6	6.1	3.0	1,378,384	614,538	136,135	7.62	457
2007	3,726,910	20.2	6.1	3.1	1,428,014	633,511	146,152	11.55	459
2008	3,306,934	20.1	6.0	3.1	1,273,885	567,911	135,143	7.5	475
2009	3,729,119	20.9	5.9	3.1	1,445,870	642,096	144,954	8.12	413
2010	3,937,456	18.2	5.4	3.1	1,300,694	593,043	121,144	6.78	550
2011	4,048,000	19.1	5.0	3.0	1,182,060	572,208	84,033	5.19	586
2012	3,941,000	18.2	4.6	3.0	1,134,415	529,157	95,282	5.89	530
2013	4,243,899	17.0	3.9	NA	1,271,221	607,704	106,594	6.1	550
2014	4,739,302	16.6	4.4	NA	1,409,511	656,971	135,032	7.56	639
2015	4,437,950	14.1	2.9	NA	1,351,221	625,004	129,630	6.7	630
2016	4,684,823	17.1	4.9	NA	1,411,029	642,647	134,813	7.34	600
2017	4,706,864	15.5	5.0	NA	1,322,302	597,342	122,687	7.7	715
2018	4,882,100	15.7	4.4	NA	1,371,264	642,868	108,467	7.0	700
2019	4,692,680	15.4	4.4	3.2	1,320,809	609,084	113,312	7.8	700
2020	4,625,293	14.2	4.0	NA	1,245,107	540,904	107,475	NA	775
Total	**105,202,556**				**34,906,261**	**16,139,566**	**3,033,063**	**169.62**	

[a]Revised slightly from Special Report 51, *Alaska's Mineral Industry 1995*, based on new company data.

[b] Totals for years 1990 through 1995 include bulk concentrate. Total for 2013 estimated from total metal produced for 2013. Beginning in 2020, this value is the concentrate shipped for the production year, which ended October 31, 2020 for the 2020 production year.

[c]Estimate calculated at 56 ounces per ton of lead metal produced from 1990 to 2004 and 2006; as reported credit for 2005, net of treatment charges; calculated at 3.1 ounces per ton of ore for 2007; estimated as proportional with increase in zinc and lead in 2013; as reported in 2014, 2016, 2017, and 2019; calculated based on recoverable silver from reported lead concentrate recovered in 2015; in 2018 calculated from tons milled, the average grades and recoveries stated in the 2017 Red Dog 43-101 report, and the assumption that Aqqaluk and Qanaiyaq contributed 80% and 20%, respectively.

[d]Includes contract employees, if known.

– = No concentrate produced

NA = Not available

Table 15. Fort Knox mine production statistics, 1996–2020.

Year	Tons mined (ore+waste)			Tons Milled (ore)			Tons Placed on Heap Leach[b]	Ounces Gold Produced	Employees
	Fort Knox	True North[a]	Total	Fort Knox	True North[a]	Total			
1996	16,684,000	0	16,684,000	769,700	0	769,700		16,085	243
1997	32,380,000	0	32,380,000	12,163,151	0	12,163,151		366,223	249
1998	33,294,000	0	33,294,000	13,741,610	0	13,741,610		365,320	245
1999	30,350,000	0	30,350,000	13,819,010	0	13,819,010		351,120	253
2000	35,600,000	0	35,600,000	15,000,000	0	15,000,000		362,929	253
2001	25,957,900	8,448,400	34,406,300	13,282,614	2,377,386	15,660,000		411,220	360
2002	24,583,500	11,461,000	36,044,500	11,887,200	3,371,800	15,259,000		410,519	360
2003	30,597,940	12,707,100	43,305,040	11,473,000	3,611,682	15,084,682		391,831	316
2004	44,187,000	3,763,000	47,950,000	12,917,966	1,675,854	14,593,820		338,334	427
2005	63,248,000	0	63,248,000	14,384,842	0	14,384,842		329,320	411
2006	51,070,000	0	51,070,000	14,839,297	0	14,839,297		333,383	406
2007	45,940,000	0	45,940,000	14,021,400	0	14,021,400		338,459	399
2008	46,300,000	0	46,300,000	15,110,000	0	15,110,000		329,105	449
2009	27,585,000	0	27,585,000	17,884,000	0	17,884,000		263,260	500
2010	42,400,000	0	42,400,000	14,560,000	0	14,560,000		349,729	525
2011	34,550,000	0	34,550,000	14,880,000	0	14,880,000		289,794	522
2012	63,120,000	0	63,120,000	14,550,000	0	14,550,000		359,948	565
2013	63,280,000	0	63,280,000	13,960,000	0	13,960,000		428,822	629
2014	49,240,000	0	49,240,000	14,920,000	0	14,920,000	28,500,000	387,285	649
2015	60,860,000	0	60,860,000	14,820,000	0	14,820,000	27,700,000	401,553	657
2016	65,240,000	0	65,240,000	14,570,000	0	14,570,000	32,124,000	409,845	660
2017	60,450,000	0	60,450,000	13,744,703	0	13,744,703	22,340,517	381,115	627
2018	71,850,000	0	71,850,000	12,996,250	0	12,996,250	17,975,390	255,569	630
2019[c]	27,962,298	0	27,962,298	8,905,562	0	8,905,562	20,373,996	200,263	655
2020[c]	31,491,894	0	31,491,894	10,090,546	0	10,090,546	25,347,618	237,925	620
Total	**1,078,221,532**	**36,379,500**	**1,114,601,032**	**329,290,851**	**11,036,722**	**340,327,573**	**278,761,521**	**8,308,956**	

[a]True North Mine started production in 2001 and suspended production in 2004.

[b]Walter Creek Heap leach facility started production in 2009, but was not tracked until 2014. Total includes 104.4 million tons placed on heap leach from 2009 through 2013.

[c]Company reported ounces of gold produced in gold-equivalent ounces.

Photo 18. The Barnes Creek heap leach facility at the Fort Knox mine near Fairbanks became operational in October 2020. Photo courtesy of Brenna Schaake, Kinross Gold Corp.

Production cost of sales totaled $251.3 million, 18 percent higher than in 2019. Depreciation, depletion, and amortization expenses totaled $97.2 million. Capital expenditures totaled $138.7 million in 2020. After exploration and other operating expenses, Kinross' Fort Knox segment reported operating earnings of $67 million.

Drilling, pit optimization, and an increase in the resource gold price assumption added 563,000 ounces of gold to measured and indicated resources and a net increase of 283,000 ounces of gold to the inferred resource, with a large portion attributed to the increase in gold price. Total reserves and resources stood at 6.1 million ounces at year-end (appendix D).

Fort Knox widened its search for mill feed in 2020. The company announced plans to mine the Gil deposit beginning in 2021. Gil lies approximately eight miles east of Fort Knox and is expected to produce 160,000 ounces of gold over a two-year mine life. In a series of transactions, Kinross purchased a 70 percent stake in the Manh Choh Project near Tok (formerly known as Peak Gold) from owners Royal Gold and Contango ORE. Kinross and Contango intend to develop the project as a joint venture, trucking the ore 250 miles to the Fort Knox mill in Fairbanks. This scenario avoids the capital costs and extended timelines associated with the design, construction, and permitting of on-site processing and tailings storage facilities. A feasibility study is expected in 2022, followed by construction in 2023 and full-scale production in 2024. The mine is anticipated to produce approximately one million ounces of gold over a four-and-a-half-year mine life. Including Manh Choh ore, Kinross expects the Fort Knox mill to operate until 2028; the heap leach facilities are expected to continue production through 2030.

TRUE NORTH RECLAMATION

True North gold mine completed reclamation and restoration of the 2,050-acre mineral development site

The work included grading 149 acres, seeding and fertilizing 270 acres, planting vegetation on 52 acres, and removing all mining buildings.

True North is one of the first modern hard rock mines on State land where operators have completed their work and the land has been returned to the State for management.

> ***"The developers leased State land, produced a valuable commodity to serve global markets, employed Alaskans, and paid state taxes and royalties. When they were done, they remediated the effects of their work and returned the land to the state for its next use. The system works."***
>
> *-DNR Commissioner Corri Feige*

Photos courtesy of Kinross Gold Corp.

Pogo Mine

Northern Star Resources' Pogo mine poured its four-millionth ounce of gold in February of 2020 (photo 19). The mine in interior Alaska consists of a set of structurally controlled, gold-bearing quartz veins that are mined underground through a combination of long-hole open stoping and cut-and-fill mining methods. The on-site mill employs gravity, flotation, and cyanide-leaching processes to recover the gold, and the entire operation employed approximately 460 full-time staff and 200 contractors in 2020.

Pogo produced 205,878 ounces of gold at an average head grade of 0.25 ounce of gold per ton, mining 914,775 tons of ore and milling 907,585 tons (table 16). Production increased over 2019 results as Northern Star phased in production from long-hole stoping in the Liese 1, Fun Zone, and South Pogo areas, decreasing the relative contribution of cut-and-fill headings.

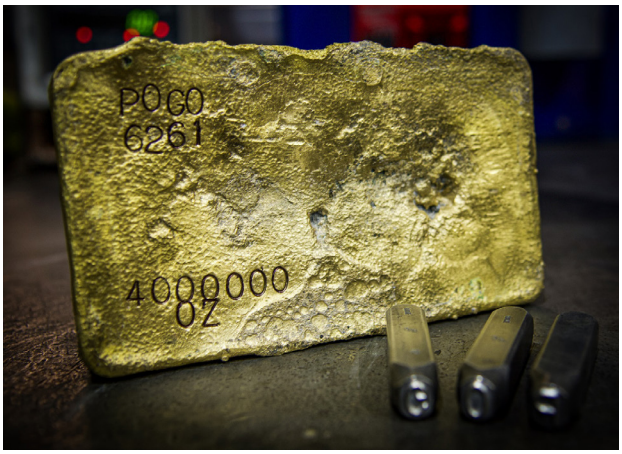


Photo 19. The Pogo mine near Delta Junction poured its four-millionth ounce of gold in February of 2020. Photo courtesy of Wendie MacNaughton, Northern Star Resources Ltd.

The change in mine plan resulted in an increase in both tonnage mined and the average grade of the mill feed. The mine began generating free cashflow again in early 2020.

Table 16. Pogo mine production statistics, 2006–2020.

Year	Tons Ore Mined	Tons Ore Milled	Ounces of Gold Recovered	Recovery (%)	Head Grade Gold (oz/ton)	Employees[a]
2006	447,129	338,000	113,364	85.0	0.395	477
2007	715,665	715,400	259,820	84.4	0.430	339
2008	882,400	818,237	347,219	83.8	0.506	285
2009	944,823	930,836	389,808	88.2	0.475	272
2010	900,585	947,189	383,434	89.6	0.452	300
2011	892,725	929,020	325,708	89.6	0.392	310
2012	815,922	875,351	315,886	89.7	0.402	335
2013[b]	963,229	875,351	337,393	90.2	0.395	320
2014	972,406	967,230	342,147	89.0	0.396	320
2015	–	–	283,000	–	–	350
2016	1,515,117	941,856	269,342	86.1	0.331	470
2017	1,602,107	974,940	271,273	88.1	0.314	470
2018[c]	1,531,890	880,075	227,901	–	–	540
2019	875,298	902,373	154,589	–	–	650
2020	914,775	907,585	205,878	89.7	0.25	660
Total	**13,974,071**	**12,003,443**	**4,226,762**			

[a]Includes contract employees, if known.

[b]Silver production of 32,000 ounces was reported in 2013.

[c] Values are underreported due to the change in ownership to Northern Star Resources in 2018.

- - = Not reported

The challenges of COVID-19 and associated protocols reduced mine development and production and reduced the number of operating diamond drill rigs from 11 to three. As Pogo completes its transition to higher throughput, the company expects to produce around 300,000 ounces of gold annually. A key part of this transition is an investment of $30 million, ongoing in 2020, to increase the processing plant throughput capacity from 1.1 to 1.4 million tons per year. This upgrade is expected to be completed in early 2021 and deliver a ~25 percent cost reduction per ton.

Northern Star continued to increase total resources during 2020, finishing the year with 25.2 million tons, grading 0.272 ounce of gold per ton, at a total of 6.9 million contained ounces of gold. This is the largest resource in the property's history (appendix D).

Usibelli Mine

Usibelli Coal Mine Inc. is a local, family-owned coal mining company that has operated in the Healy area since 1943. The company mines subbituminous coal from the Miocene Suntrana Formation, mainly from leases on State land in the Hoseanna Creek and Jumbo Dome areas. There are four active and past coal resources: Two Bull Ridge, Gold Run Pass, Jumbo Dome, and Poker Flats. The company is currently mining Two Bull Ridge, which has more than 10 million tons of coal slated for production. The Two Bull Ridge resource has 3.5–5 cubic yards of overburden for each ton of coal, which is contained in multiple seams. Number 3 seam averages 18 feet thick, Number 4 seam is up to 32 feet thick, and Number 6 seam averages 21 feet thick. Gold Run Pass is nearing completion of its mining life, with four of five reclamation stages complete. The Jumbo Dome mine region contains approximately 250 million tons of coal, of which about 80 million tons have been permitted. Number 4 seam averages 40 feet thick with 25–75 feet of overburden above it, and Number 3 seam averages 30 feet thick with 35 feet of overburden between it and Number 4 seam. Stripping ratios are 0.5 cubic yards of overburden per one ton of coal. Poker Flats, now fully reclaimed, produced about 27 million tons of coal beginning in the 1970s.

In 2020 Usibelli produced about 1,000,000 tons of coal from its Two Bull Ridge and Jumbo Dome mine sites. The majority of Usibelli's coal is used for in-state electrical power generation at interior Alaska coal-fired power plants. The University of Alaska Fairbanks recently commissioned a new boiler and 17-megawatt turbine generator; Eielson Air Force Base is replacing multiple boilers. Golden Valley Electric Association achieved first commercial production in November 2018 for their Healy Number 2 power plant, a 50-megawatt coal-fired electrical plant at the mouth of the Usibelli mine. At full capacity it is projected to use about 200,000 tons of coal per year.

Kensington Mine

Kensington mine is 45 miles north–northwest of Juneau, and is 100 percent owned by Coeur Alaska, Inc., a wholly-owned subsidiary of Coeur Mining, Inc. It falls within the Berners Bay Mining District at the northern-most edge of the Juneau Gold Belt. The underground Kensington mine consists of at least three major, structurally controlled, orogenic-gold vein systems (Kensington Main, Jualin, and Raven), which are being mined by long-hole stoping and drift-and-fill methods, with gold recovered using flotation processes (photo 20). Kensington mine reserves totaled 331,000 ounces of gold as of December 31, 2020, and additional resources are tabulated in appendix D.

Restrictions mitigating the COVID-19 pandemic added expense and impacted mine workers. Rotation schedules were extended from two weeks to four weeks on-site, and workers arriving at site were required to undergo testing and quarantine prior to starting their work rotations. Despite these challenges, the mine remained in operation as an essential business and achieved production and exploration results in line with expectations.

Kensington employed 368 employees during 2020, not including contractors. The

mill processed 675,731 tons of material at an average grade of 0.20 ounce of gold per ton with an average 93.0 percent recovery rate (table 17). Full-year production was 124,867 ounces of gold, a decline of two percent from 2019. Metal sales from Kensington totaled $216.5 million. Costs applicable to sales for the year were $975 per ounce of gold, amortization was $49.5 million, and total sustaining and development capital expenditures were $19.8 million.

The U.S. Forest Service continued work on a Supplemental Environmental Impact Statement (SEIS) evaluating Coeur Alaska's proposed Plan of Operations Amendment 1, anticipated to extend Kensington's mine life by 10 years to 2033. The Draft SEIS was released in October 2020 and underwent a public comment period ending in early January 2021. Coeur Alaska anticipates receiving the Final SEIS and draft Record of Decision in June 2021.

Photo 20. Mining underground at the Kensington mine in southeast Alaska. Photo courtesy of Jan Trigg, formerly of Coeur Alaska, Inc.

Table 17. Kensington mine production statistics, 2010–2020.

Year	Ore (tons milled)	Ore Grade Gold (oz/ton)	Gold Recovery (%)	Gold Produced (oz)
2010[a]	174,028	0.28	89.9	43,143
2011	415,340	0.23	92.7	88,420
2012	394,780	0.22	95.6	82,125
2013	553,717	0.21	96.6	114,821
2014	635,960	0.20	94.1	117,823
2015	659,786	0.20	94.9	128,865
2016	620,209	0.21	94.7	124,331
2017	668,727	0.18	93.5	115,094
2018	641,058	0.18	92.3	113,778
2019	658,378	0.21	91.0	127,914
2020	675,731	0.20	93.0	124,867
Total	**6,097,714**			**1,181,181**

[a]Production started July 3, 2010.

Greens Creek Mine

Greens Creek mine, owned and operated by Hecla Mining Company, is a polymetallic, silver-rich VMS deposit located about 20 miles southwest of Juneau. The underground mine is accessed by a ramp from surface and is primarily mined by cut-and-fill and long-hole stoping (photo 21). The 2,300 ton-per-day mill includes a SAG and ball mill grinding circuit, a gravity circuit to recover free gold and electrum, and a flotation circuit that produces three types of concentrates. Hecla employed 442 workers at Greens Creek in 2020.

Measures to limit the spread of COVID-19 greatly affected mine operations and employees, but production remained at levels comparable to prior years. Out-of-state workers were required to quarantine at a hotel in Juneau prior to arriving on site, and on-site rotations for workers living in the mine camp doubled to four weeks.

Greens Creek processed 818,408 tons of ore in 2020, yielding 10.5 million ounces of silver, 48,491 ounces of gold, 56,814 tons of zinc, and 21,400 tons of lead (table 18). Due to rising head grades, silver production rose six percent over 2019 levels despite a three percent decline in tons milled. Ore grades milled were 15.65 ounces of silver per ton, 0.08 ounce of gold per ton, 3.13 percent lead, and 7.58 percent zinc.

Hecla had 2020 sales of $327.8 million, yielding $110.7 million in gross profit—an increase of 26 percent over 2019—after production and sales costs, depreciation, depletion, and amortization. The increase was due to increased production of silver, lead, and zinc, coupled with increases in the prices of silver and gold. The total production cost per ton was $179.37, a 15 percent increase over 2018, reflecting increased labor and maintenance costs as well as COVID-19-related costs. The total cash cost of production, after byproduct credits, was $5.49 per ounce of silver. Greens Creek spent $28.8 million on capital additions, including underground access and capitalized resource drilling.

Photo 21. A truck hauls ore out of Hecla Mining Company's Greens Creek mine near Juneau. Last accessed December 6, 2021; www.hecla-mining.com/greens-creek/.

Table 18. Greens Creek mine production statistics, 1989–2020.

Year	Tons Milled	Tons Concentrate	Metal Produced					Employees
			Tons Zinc	Tons Lead	Tons Copper[a]	Ounces Gold	Ounces Silver	
1989	264,600	–	187,007	9,585	–	23,530	5,166,591	235
1990	382,574	–	37,000	16,728	–	38,103	7,636,501	265
1991	380,000	–	41,850	16,900	–	37,000	7,600,000	238
1992	365,000	113,827	40,500	16,500	–	32,400	7,100,000	217
1993[b]	77,780	–	9,500	3,515	–	7,350	1,721,878	217
1994[c]	–	–	–	–	–	–	–	–
1995[c]	–	–	–	–	–	–	–	–
1996[b]	135,000	43,000	9,100	4,200	193	7,480	2,476,000	265
1997	493,000	–	46,000	19,000	1,300	56,000	9,700,000	275
1998	540,000	–	58,900	22,700	1,300	60,572	9,500,000	275
1999	578,358	–	68,527	25,503	1,400	80,060	10,261,835	275
2000	619,438	–	84,082	31,677	1,400	128,709	12,424,093	275
2001	658,000	–	63,903	22,385	1,400	87,583	10,900,000	275
2002	733,507	217,200	80,306	27,582	1,600	102,694	10,913,183	262
2003	781,200	–	76,200	24,800	–	99,000	11,707,000	295
2004	805,789	–	69,115	21,826	–	86,000	9,707,000	265
2005	717,600	–	58,350	18,600	–	72,800	9,700,000	265
2006	732,176	–	59,429	20,992	–	62,935	8,865,818	245
2007	732,227	–	62,603	21,029	–	68,006	8,646,825	276
2008	734,910	–	58,224	18,562	–	67,269	7,145,711	336
2009	790,871	–	70,379	22,253	–	67,278	7,459,170	321
2010	800,397	–	74,496	25,336	–	68,838	7,206,973	343
2011	772,069	–	66,050	21,055	–	56,818	6,498,337	364
2012	789,569	–	64,249	21,074	–	55,496	6,394,235	386
2013	805,322	–	57,614	20,114	–	57,457	7,448,347	390
2014	816,213	–	59,810	20,151	–	58,810	7,826,341	415
2015	814,398	–	61,934	21,617	–	60,566	8,452,153	418
2016	815,639	–	57,729	20,596	–	53,912	9,253,543	414
2017	839,589	–	52,547	17,996	–	50,854	8,351,882	423
2018	845,398	–	55,350	18,960	–	51,493	7,953,003	426
2019	846,076	–	56,805	20,112	–	56,625	9,890,125	426
2020	818,408	–	56,814	21,400	–	48,491	10,494,726	442
Total	**19,485,108**	–	**1,844,373**	**592,748**	**8,593**	**1,804,129**	**248,401,270**	

[a]No copper credits in 1989–1993 and 2003–2020.
[b]Partial-year production.
[c]No production in 1994 and 1995 due to mine closure.
– = Not reported

Definition drilling at Greens Creek in 2020 focused on upgrading resources in the 200 South, East Ore, Southwest, 9a, and Upper Plate zones. At year-end 2020 the mine plan included reserves and resources sufficient for approximately 11 years of production (appendix D).

Donlin Gold Project

Donlin Gold, a proposed large open-pit gold mine in southwest Alaska, is a 50/50 partnership between Barrick Gold Corp. and NovaGold Resources Inc. The deposit contains proven and probable reserves of 34 million ounces of gold at an average grade of 0.06 ounce of gold per ton (appendix D) and would be one of the world's largest gold mines if built. See Exploration Section for Donlin Gold permitting activity in 2020.

Dawson Mine

The Dawson mine is located on Prince of Wales Island in southeastern Alaska, about 3.5 miles from the Hollis ferry terminal. It is operated by Sundance Mining Group LLC. The Dawson mine exploits a medium-sized, low-sulfide, high-grade, free-milling gold–silver deposit. Veins are hosted by shale and siltstone of the Descon Formation, which locally contains sills and dikes. The quartz-vein system dips 28 degrees, and ore minerals include galena, chalcopyrite, sphalerite, tellurides, and free gold. Ore occurs within a linear north-trending zone, which, from south to north, includes the historical Harris River mine, Dawson mine, Upper Crackerjack workings, and Puyallup mine. Mill site development was completed in 2018 and a 150-ton-per-day gravity mill was installed. The mine began production in 2019 and continued operating during 2020, according to MSHA records.

Calder Mine

Calder mine is located on the northern end of Prince of Wales Island, 88 miles west of Ketchikan. It was developed as a dimensional marble quarry in the early 20th century, but although the marble is bright white, it didn't meet specifications for monuments or architecture, and the quarry closed after several years of operation. Toward the end of the century, the quarry was restarted by Sealaska Corporation to supply calcium carbonate to various industries. In 2011 Columbia River Carbonates (CRC) purchased the property and began development and renovation of existing infrastructure. Currently, Calder mine has a proven ore reserve that is expected to last at least 75 years, with resource-expansion potential. The ore body is classified as being uniquely pure and yields uniform, bright white stone. The mine operates on a seasonal basis; barges carry the stone to CRC's plant in Woodland, Washington, where it is turned into a range of wet and dry calcium carbonate products for use in the paper, glass, plastics, paint, construction, agriculture, and other industries.

DRILLING

Nineteen companies publicly reported drilling programs in Alaska in 2020 across all sectors (table 19). Total drilling, including both publicly reported and confidential drilling footages, increased to 1,972,635 feet (table 20). Development drilling totaled 496,176 feet, and production drilling totaled 809,019 feet. Large increases in pre-production drilling are likely due to changes in reporting methods rather than increased activity. Twenty individual projects reported 667,439 feet of exploration drilling in 2020, down from twenty-eight projects in 2019, but with a 60 percent increase in footage drilled. Exploration at mine sites totaled 256,075 feet, 38 percent of total exploration, while 411,365 feet of exploration drilling took place at 16 non-mine exploration projects. Globally, the number of exploration projects with drilling programs and the number of drill holes increased 0.5 percent and five percent, respectively.[6]

Drilling footage was primarily compiled from questionnaires, public company reports, and online information, and represents a minimum amount for 2020. Production drilling is likely under-reported, and placer exploration drilling in 2020 was not compiled. Blast-hole drilling during production at Alaska's large lode mines was not tracked.

Table 19. Companies publicly reporting significant drilling programs in Alaska in 2020.

Avidian Gold	HighGold Mining Inc.
Blackwolf Copper and Gold Ltd.	Kinross Gold Corp.
Coeur Alaska Inc.	Northern Star Resources Ltd.
Donlin Gold LLC	Nova Minerals Ltd.
Freegold Ventures Ltd.	Peak Gold LLC
Great American Minerals Exploration Inc.	PolarX Ltd.
Grand Portage Resources Ltd.	Resolution Minerals Ltd.
Hecla Mining Company	Tectonic Metals Inc.
Heliostar Metals Ltd.	Western Alaska Copper & Gold
	White Rock Minerals Ltd.

Table 20. Drilling footage reported or estimated in Alaska, 1982–2020.

Year	Placer Exploration	Placer Thawing	Total Placer	Total Coal	Hardrock Core[a]	Hardrock Rotary[a]	Total Hardrock	Total Feet Drilled
1982	30,000	94,000	124,000	80,000	–	–	200,000	404,000
1983	23,000	30,000	53,000	12,000	–	–	180,500	245,500
1984	31,000	98,000	129,000	25,700	–	–	176,000	330,700
1985	46,000	34,000	80,000	8,700	–	–	131,700	220,400
1986	32,400	227,000	259,400	28,800	–	–	50,200	338,400
1987	50,250	130,000	180,250	19,900	95,600	19,500	115,100	315,250
1988	152,000	300,000	452,000	26,150	223,630	130,230	353,860	832,010
1989	97,250	210,000	307,250	38,670	242,440	89,790	332,230	678,150
1990	78,930	105,000	183,930	18,195	648,600	112,355	760,955	963,080
1991	51,247	130,000	181,247	16,894	205,805	110,850	316,655	514,796
1992	6,740	65,000	71,740	12,875	211,812	148,022	359,834	444,449
1993	25,216	–	25,216	–	124,325	127,990	252,315	277,531
1994	21,000	–	21,000	8,168	347,018	91,692	438,710	467,878
1995	27,570	–	27,570	–	363,690	51,795	415,485	443,055
1996	61,780	–	61,780	8,500	524,330	134,527	658,857	729,137
1997	38,980	–	38,980	13,998	523,676	180,834	704,510	757,488
1998	33,250	–	33,250	2,300	505,408	45,670	551,078	586,628
1999	6,727	–	6,727	–	369,863	78,934	448,797	455,524
2000	15,480	–	15,480	–	418,630	127,638	546,268	561,748
2001	1,100	–	1,100	36,151	240,318	75,750	316,068	353,319
2002	1,250	–	1,250	–	385,290	103,612	488,902	490,152
2003	10,108	–	10,108	2,000	270,456	100,178	370,634	382,742
2004	107,526	–	107,526	–	415,628	36,024	451,652	559,178
2005	3,360	–	3,360	–	592,497	41,780	634,277	637,637
2006	8,759	–	8,759	7,500	765,363	54,173	819,536	835,795
2007	19,575	–	19,575	50,539	830,478	268,112	1,098,590	1,168,704
2008	1,216	–	1,216	26,869	874,634	250,278	1,124,912	1,152,997
2009	1,244	–	1,244	W	403,275	260,059	663,334	664,578
2010	10,427	–	10,427	11,601	688,911	216,768	905,679	927,707
2011	3,150	–	3,150	W	883,272	175,181	1,058,453	1,061,603
2012	13,282	–	13,282	7,704	1,082,439	14,182	1,096,621	1,117,607
2013	17,986	–	17,986	W	933,194	17,800	950,994	968,980
2014	7,227	–	7,227	W	487,106	9,736	496,842	504,069
2015	–	–	–	W	923,324	12,795	937,769	937,769
2016	–	–	–	–	644,512	W	644,512	644,512
2017	–	–	–	W	1,016,731	W	1,016,731	1,016,731
2018	–	–	–	W	1,039,089	W	1,039,089	1,039,089
2019	–	–	–	W	812,933	35,267	848,200	848,200
2020[b]	–	–	–	–	1,917,082	55,553	1,972,635	1,972,635

[a]Core and rotary drilling not differentiated prior to 1987.

[b]Changes in reporting of pre-production drilling at some sites explain the increase from 2019.

– = Not reported

W = withheld for confidentiality; included in hardrock rotary or core.

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APPENDIX A
Resources Related to the Minerals Industry in Alaska

DEPARTMENT OF NATURAL RESOURCES

Recording Fees – dnr.alaska.gov/ssd/recoff/fees_RO.cfm
Public Information Center – dnr.alaska.gov/commis/pic/
State Uniform Commercial Code (UCC) Documents Search – dnr.alaska.gov/ssd/recoff/ucc

Division of Mining, Land & Water

Mining Applications and Forms – dnr.alaska.gov/mlw/forms/
Fact Sheets – dnr.alaska.gov/mlw/factsht/
Annual Placer Mining Application (APMA) – dnr.alaska.gov/mlw/mining/placer.cfm
Annual Rental – dnr.alaska.gov/mlw/cdn/pdf/factsheets/annual-rent.pdf
Leasing State Land – dnr.alaska.gov/mlw/cdn/pdf/factsheets/leasing-state-land.pdf
Land Lease & Contract Payment Information – dnr.alaska.gov/mlw/cdn/pdf/factsheets/land-lease-and-contract-payment-information.pdf
Production Royalty – dnr.alaska.gov/mlw/cdn/pdf/factsheets/production-royalty.pdf
DNR Production Royalty Form – dnr.alaska.gov/mlw/cdn/pdf/forms/Production-Royalty-Form-2020-v2.pdf
Exploration Incentive Credit Program – dnr.alaska.gov/mlw/cdn/pdf/factsheets/exploration-incentive-credit-program.pdf

Division of Geological & Geophysical Surveys

Publications On-Line – dggs.alaska.gov/pubs/
Interactive Maps – maps.dggs.alaska.gov
Geologic Maps of Alaska: Online Map Search Tool – maps.dggs.alaska.gov/mapindex/
Unpublished Geology-Related Data (Alaska Geologic Data Index) – maps.dggs.alaska.gov/agdi/
Geologic Materials Center – dggs.alaska.gov/gmc/
Alaska Geochemistry Web Map – maps.dggs.alaska.gov/geochem/
Alaska Geospatial Council – agc.dnr.alaska.gov/

Alaska's Minerals Data & Information Rescue in Alaska (MDIRA) Project Websites

MDIRA Portal Home Page – akgeology.info
Alaska Mining Claims Mapper – mapper.dnr.alaska.gov
Land Records Web Application – dnr.alaska.gov/landrecords
State Recorder's Office Search – dnr.alaska.gov/ssd/recoff/searchRO.cfm
Alaska Resource Data File – ardf.wr.usgs.gov
USGS Alaska Geochemical Database, Version 3.0 (NURE, RASS, PLUTO…) – pubs.er.usgs.gov/publication/ds1117

DEPARTMENT OF COMMERCE, COMMUNITY, AND ECONOMIC DEVELOPMENT

Community and Regional Information – www.commerce.alaska.gov/web/dcra/ResearchAnalysis
Alaska Industrial Development and Export Authority (AIDEA) – www.aidea.org
AIDEA Supports Mining – www.aidea.org/Programs/ProjectDevelopment/35YearsofMiningSupport.aspx

DEPARTMENT OF REVENUE

Mining License Tax – www.tax.alaska.gov/programs/programs/index.aspx?60610
Motor Fuel Tax Claim for Refund – www.tax.alaska.gov//programs/programs/forms/index.aspx?60210
Alaska Motor Fuel Tax Instructions – www.tax.alaska.gov/programs/documentviewer/viewer.aspx?5086f

APPENDIX B

Primary metals production in Alaska, 1880–2020[a]

Year	Gold[b]		Silver		Mercury		Antimony		Tin	
	(oz)	(m$)	(oz)	(t$)	(flask[c])	(t$)	(lb)	(t$)	(lb)	(t$)
1880–99	1,153,889	$23.9	496,101	$329.0	–	–	–	–	–	–
1900–09	6,673,173	137.9	1,324,580	779.5	–	–	–	–	304,000	$112.2
1910–19	7,209,094	149.0	7,058,235	5,107.5	–	–	2,760,000	W	1,640,000	805.9
1920–29	3,373,336	69.8	6,407,375	5,160.8	117	$7.6	W	W	317,800	163.9
1930–39	5,345,205	150.8	3,250,173	1,889.8	31	2.3	1,616,000	$228.3	1,024,400	502.1
1940–49	3,137,447	109.8	794,842	577.0	3,094	724.3	2,062,080	311.1	319,200	230.3
1950–59	2,297,827	80.6	321,669	292.9	18,185	4,370.0	2,663,520	3,697.6	1,144,000	1,310.5
1960–69	751,870	26.6	59,300	70.7	13,996	3,098.0	228,800	267.8	–	–
1970–79	324,906	55.8	54,700	250.5	4,040	1,694.0	1,473,000	1,714.0	166,000	949.0
1980	75,000	32.0	7,500	111.0	–	–	–	–	120,000	984.0
1981	134,200	55.2	13,420	111.3	W	W	–	–	106,000	700.0
1982	175,000	69.9	22,000	198.0	–	–	–	–	198,000	1,365.0
1983	169,000	67.6	33,200	332.0	–	–	22,400	45.0	215,000	1,100.0
1984	175,000	62.1	20,000	159.0	5	1.5	135,000	225.8	225,000	400.0
1985	190,000	61.2	28,500	171.0	27	10.0	65,000	98.0	300,000	650.0
1986	160,000	60.8	24,000	134.4	12	2.8	45,000	67.5	340,000	890.0
1987	229,707	104.5	54,300	391.0	–	–	–	–	288,000	460.0
1988	265,500	112.8	47,790	282.0	W	W	–	–	300,000	950.0
1989	284,617	108.7	5,211,591	27,300.0	–	–	–	–	194,000	672.0
1990	231,700	89.2	10,135,000	50,675.0	–	–	–	–	57,000	200.0
1991	243,900	88.3	9,076,854	39,110.0	–	–	–	–	6,800	22.1
1992	262,530	88.5	9,115,755	34,913.0	–	–	–	–	1,500	5.9
1993	191,265	68.6	5,658,958	24,333.0	–	–	–	–	21,000	50.6
1994	182,100	70.3	1,968,000	10,391.0	–	–	–	–	–	–
1995	141,882	56.0	1,225,730	6,655.0	–	–	–	–	–	–
1996	161,565	62.6	3,676,000	19,078.0	–	–	–	–	–	–
1997	590,516	207.3	14,401,165	70,710.0	–	–	–	–	–	–
1998	594,191	174.6	14,856,000	82,154.0	–	–	–	–	–	–
1999	517,890	144.3	16,467,000	85,628.0	–	–	–	–	–	–
2000	551,982	154.1	18,226,615	90,404.0	–	–	–	–	–	–
2001	550,644	149.3	16,798,000	73,408.0	–	–	–	–	–	–
2002	562,094	174.3	17,858,183	82,326.0	–	–	–	–	–	–
2003	528,191	191.9	18,589,100	95,300.0	–	–	–	–	–	–
2004	456,508	192.3	16,947,270	113,056.9	–	–	–	–	–	–
2005	427,031	189.9	11,670,000	85,382.0	–	–	–	–	–	–
2006	570,129	344.1	16,489,394	190,415.9	–	–	–	–	–	–
2007	726,933	511.1	20,203,985	270,402.1	–	–	–	–	–	–
2008	800,752	698.2	14,643,735	219,496.4	–	–	–	–	–	–
2009	780,657	759.1	15,617,436	229,159.3	–	–	–	–	–	–
2010	914,462	1,119.8	13,991,297	282,523.5	–	–	–	–	–	–
2011	848,945	1,334.1	11,683,967	410,340.9	–	–	–	–	–	–
2012	921,240	1,537.5	12,313,877	383,573.6	–	–	–	–	–	–
2013	1,022,987	1,551.9	13,453,367	320,121.0	–	–	–	–	–	–
2014	948,547	1,201.2	15,388,901	304,392.5	–	–	–	–	–	–
2015	941,394	1,013.9	15,147,249	237,508.9	–	–	–	–	–	–
2016	909,242	1,119.3	16,621,035	246,109.8	–	–	–	–	–	–
2017	859,631	1,064.0	16,085,142	274,163.2	–	–	–	–	–	–
2018	711,986	888.3	15,116,355	210,826.8	–	–	–	–	–	–
2019	589,080	802.5	17,674,583	258,052.1	–	–	–	–	–	–
2020	651,418	1,105.4	17,997,209	321,364.2	–	–	–	–	–	–
Other[e]	489,537	–	–	–	1,438	–	–	–	–	–
Total	**51,005,701**	**$18,690.9**	**444,326,438**	**$5,165,621.6**	**40,945**	**$9,910.5**	**11,070,800**	**$6,655.1**	**7,287,700**	**$12,523.5**

t$ = thousands of dollars m$ = millions of dollars - - = Not reported
W = withheld

[a]From published and unpublished State and Federal documents. Where State and Federal figures differ significantly, State figures are used. Please refer to previous editions of this appendix for year-to-year production information for years 1900 to 1979.

[b]Gold production adjusted to be more consistent with mining district production totals.

[c]76-lb flask.

[d]Crude platinum; total production of refined metal is about 575,000 oz.

[e]Not traceable by year

APPENDIX B, CONTINUED

Primary metals production in Alaska, 1880–2020[a]

Year	Lead		Zinc		Platinum[d]		Copper		Chromium	
	(tons)	(t$)	(tons)	(t$)	(oz)	(t$)	(lb)	(m$)	(tons)	(t$)
1880–99	250	$ 17.0	–	–	–	–	–	–	–	–
1900–09	369	32.8	–	–	–	–	29,549,486	$ 4.8	–	–
1910–19	3,565	470.2	–	–	914	$116.5	515,253,817	109.9	2,200	W
1920–29	7,961	1,084.1	–	–	5,750	484.9	643,576,929	93.3	–	–
1930–39	10,791	914.3	–	–	102,615	5,427.1	184,522,000	19.5	–	–
1940–49	3,096	405.2	678	$ 0.5	225,285	12,623.3	433,700	0.2	7,409	$ 250.9
1950–59	177	38.6	–	–	107,927	9,403.9	106,000	0.1	21,442	1,975.8
1960–69	40	9.9	–	–	111,556	13,618.5	352,000	0.1	–	–
1970–79	20	8.0	–	–	41,604	6,826.0	–	–	8,000	1,200.0
1980	31	29.0	–	–	–	–	–	–	–	–
1981	–	–	–	–	900	200.0	–	–	–	–
1982	–	–	–	–	W	W	–	–	–	–
1983	–	–	–	–	W	W	–	–	–	–
1984	–	–	–	–	W	W	–	–	–	–
1985	–	–	–	–	–	–	–	–	–	–
1986	–	–	–	–	W	W	–	–	–	–
1987	–	–	–	–	W	W	–	–	–	–
1988	–	–	–	–	25	13.8	–	–	–	–
1989	9,585	7,700.0	19,843	29,400.0	–	–	–	–	–	–
1990	44,220	30,954.0	181,200	253,680.0	–	–	–	–	–	–
1991	69,591	33,403.7	278,221	278,221.0	15	5.3	–	–	–	–
1992	68,664	31,585.0	274,507	301,957.7	–	–	–	–	–	–
1993	38,221	13,759.6	268,769	236,516.7	3	1.2	–	–	–	–
1994	36,447	25,512.9	329,003	296,102.7	5	2.1	–	–	–	–
1995	58,098	34,428.6	359,950	345,552.0	1	0.4	–	–	–	–
1996	70,086	52,284.0	366,780	361,646.0	2	0.8	780,000	0.8	–	–
1997	88,560	49,593.0	419,097	494,888.0	–	–	3,440,000	3.5	–	–
1998	102,887	49,386.0	549,348	505,400.0	–	–	3,800,000	2.9	–	–
1999	125,208	57,596.0	643,642	630,769.0	–	–	4,200,000	3.0	–	–
2000	123,224	51,754.0	669,112	682,494.0	–	–	2,800,000	2.3	–	–
2001	127,385	56,049.0	634,883	507,907.0	–	–	2,800,000	2.0	–	–
2002	146,462	61,514.0	718,103	502,674.0	–	–	3,200,000	2.3	–	–
2003	162,479	64,279.0	714,769	536,348.0	–	–	–	–	–	–
2004	150,796	120,636.8	680,015	651,432.2	–	–	–	–	–	–
2005	131,366	115,230.0	684,462	862,108.0	–	–	–	–	–	–
2006	157,128	183,629.3	673,967	2,002,971.4	–	–	–	–	–	–
2007	167,181	389,532.2	696,115	2,048,451.6	–	–	87,627	0.3	–	–
2008	153,705	287,428.4	626,135	1,055,220.1	–	–	–	–	–	–
2009	167,204	260,838.2	712,496	1,068,744.0	–	–	–	–	–	–
2010	146,480	284,171.2	667,539	1,212,390.3	–	–	–	–	–	–
2011	113,649	247,755.2	696,793	1,379,649.2	5,000	8,609.3	1,058	0.0	–	–
2012	126,234	234,795.2	647,481	1,139,566.6	–	–	14,327	0.0	–	–
2013	126,707	245,811.6	665,318	1,157,653.3	–	–	77,240	0.3	–	–
2014	155,183	294,847.2	716,781	1,404,890.4	–	–	–	–	–	–
2015	151,247	245,126.5	686,938	1,204,315.0	–	–	–	–	–	–
2016	155,409	241,931.4	700,376	1,250,186.4	–	–	–	–	–	–
2017	140,683	288,118.8	649,889	1,639,020.1	–	–	–	–	–	–
2018	127,427	252,176.4	698,218	1,851,779.3	–	–	–	–	–	–
2019	133,424	233,202.7	665,889	1,486,129.0	–	–	–	–	–	–
2020	128,875	199,206.8	597,718	1,164,745.5	–	–	–	–	–	–
Other[e]	–	–	–	–	71,946	17,091.9	–	–	–	–
Total	**3,730,115**	**$4,747,245.7**	**17,894,034**	**$28,542,809.0**	**673,548**	**$57,333.1**	**1,394,994,184**	**$245.3**	**39,051**	**$3,426.7**

t$ = thousands of dollars m$ = millions of dollars - - = Not reported
W = withheld

[a]From published and unpublished State and Federal documents. Where State and Federal figures differ significantly, State figures are used. Please refer to previous editions of this appendix for year-to-year production information for years 1900 to 1979.

[b]Gold production adjusted to be more consistent with mining district production totals.

[c]76-lb flask.

[d]Crude platinum; total production of refined metal is about 575,000 oz.

[e]Not traceable by year

APPENDIX C

Production of industrial minerals, coal, and other commodities in Alaska, 1880–2020[a,b]

Year	Coal		Sand and Gravel[c]		Rock[d]		Barite		Other[e]
	short tons	m$	short tons	m$	short tones	m$	short tons	t$	$
1880–99	19,429	$0.1	–	–	7,510	–	–	–	--
1900–09	33,214	0.2	–	–	15,318	–	–	–	$246,403
1910–19	210,806	1.2	–	–	50,014	–	–	–	2,014,788
1920–29	937,860	5.2	–	–	494,417	–	–	–	2,523,754
1930–39	1,222,797	5.5	42,332	$0.0	689,676	–	–	–	899,767
1940–49	3,189,026	20.2	1,758,504	0.7	286,341	–	–	–	27,124,158
1950–59	6,632,641	59.7	65,804,686	55.1	1,843,560	–	–	–	25,443,427
1960–69	7,849,000	58.8	163,315,000	176.7	2,034,000	–	225,000	$1,200.0	34,143,000
1970–79	7,405,000	89.0	489,522,000	1,004.9	47,930,000	–	502,000	8,217.0	77,501,000
1980	800,000	16.0	40,000,000	86.0	3,700,000	–	50,000	2,000.0	97,500
1981	800,000	17.6	46,000,000	88.2	4,200,000	–	–	–	256,000
1982	830,000	18.0	45,000,000	91.0	3,400,000	–	–	–	150,000
1983	830,000	18.0	50,000,000	105.0	5,270,000	–	–	–	242,000
1984	849,161	23.8	27,000,000	95.0	2,700,000	–	–	–	875,875
1985	1,370,000	39.7	28,184,080	112.1	2,500,000	–	–	–	559,000
1986	1,492,707	40.1	20,873,110	75.8	4,200,000	–	–	–	384,800
1987	1,508,927	42.4	16,696,374	42.7	1,805,000	–	–	–	388,400
1988	1,551,162	44.3	17,264,500	48.8	3,600,000	–	–	–	389,000
1989	1,452,353	41.5	14,418,000	39.9	2,914,000	–	–	–	1,492,000
1990	1,576,000	45.0	15,013,500	40.8	3,200,000	–	–	–	400,000
1991	1,540,000	39.0	14,160,011	45.5	3,000,000	–	–	–	462,000
1992	1,531,800	38.3	14,599,746	42.2	2,900,000	–	–	–	430,000
1993	1,586,545	38.1	13,162,402	40.6	3,561,324	–	–	–	465,000
1994	1,490,000	36.8	13,518,321	41.0	3,843,953	–	–	–	459,500
1995	1,640,000	41.3	9,847,550	30.9	2,811,152	–	–	–	182,500
1996	1,481,000	38.0	9,890,463	32.2	3,000,045	–	–	–	200,000
1997	1,446,000	38.1	13,800,000	51.9	3,200,000	–	–	–	217,000
1998	1,339,000	35.2	12,363,450	57.3	1,636,200	–	–	–	215,000
1999	1,560,000	41.1	10,600,000	52.4	1,640,000	–	–	–	190,000
2000	1,473,355	38.8	10,600,000	49.9	5,200,000	–	–	–	203,000
2001	1,537,000	48.1	10,360,000	55.2	3,091,000	–	–	–	205,000
2002	1,158,000	37.4	22,412,000	120.7	3,152,000	–	–	–	200,000
2003	1,088,000	38.1	11,868,001	64.1	861,382	–	–	–	175,000
2004	1,450,000	50.8	19,576,092	101.5	7,312,050	–	–	–	2,732,554
2005	1,402,174	49.1	16,620,009	76.5	2,803,172	–	–	–	809,642
2006	1,397,500	48.9	13,953,465	63.4	2,369,738	–	–	–	1,057,500
2007	1,273,004	44.6	14,163,676	76.1	2,211,954	–	–	–	1,085,500
2008	1,538,000	53.8	12,461,685	72.4	2,485,820	–	–	–	1,159,502
2009	1,861,714	65.2	7,072,037	41.4	1,837,090	–	–	–	3,678,930
2010	2,061,000	72.1	6,977,297	48.0	290,852	–	–	–	2,303,950
2011	2,220,000	77.7	5,862,851	38.7	499,722	–	–	–	3,200,000
2012	2,018,759	70.7	7,799,994	52.3	1,050,762	–	–	–	–
2013	1,600,000	56.0	11,622,045	79.6	364,632	–	–	–	1,900,000
2014	1,500,000	52.5	526,509	6.8	1,147,869	–	–	–	120,000
2015	1,177,390	41.2	5,725,541	17.2	–	–	–	–	–
2016	930,987	32.6	6,123,896	17.3	–	–	–	–	–
2017	873,000	30.6	3,918,110	11.6	–	–	–	–	–
2018	1,000,000	35.0	4,010,671	10.5	–	–	–	–	–
2019	1,000,000	35.0	2,728,570	7.8	–	–	–	–	–
2020	1,020,870	51.0	2,076,879	5.7	–	–	–	–	–
Other	–	–	–	–	2,300,000[f]	W	79,000	W	–
Total	**83,755,181**	**$1,961.0**	**1,349,293,356**	**$3,473.3**	**153,410,553**	**$952.5**	**856,000**	**$11,417.0**	**$196,782,450**

[a]From published and unpublished State and Federal documents. Where State and Federal figures differ significantly, State figures are used.

[b]Please refer to previous editions of this appendix for year-to-year production information for years 1900 to 1979.

[c]As of 2015, rock, sand, and gravel are reported as a combined commodity.

[d]Building-stone production figures for 1880-1937 are for the southcentral and interior regions of Alaska only.

[e]Includes 2.4 million lb U3O8 (1955–1971); 505,000 tons gypsum (1905–1926); 286,000 lb WO3 (intermittently, 1916–1980); 94,000 lb asbestos (1942–44); 540,000 lb graphite (1917–1918 and 1942–1950); and undistributed amounts of zinc, jade, peat, clay, soapstone, miscellaneous gemstones, and other commodities (1880–present).

[f]Marble quarried on Prince of Wales Island, southeastern Alaska (1900–1941).

m$ = millions of dollars t$ = thousands of dollars – = not reported W = withheld

APPENDIX D

Identified mineral resources of Alaska deposits

DEPOSIT—Type—Metal Suite														
Phase	Category	Short Tons of Resource	Cu %	Cu thousand pounds	Pb %	Pb thousand pounds	Zn %	Zn thousand pounds	Au oz/ton	Au thousand ounces	Ag oz/ton	Ag thousand ounces	Mo %	Mo thousand pounds	Other grade	Other quantity
KENSINGTON — Gold veins — Precious metals (gold) Source: Coeur Reports Year-End 2020 Mineral Reserves and Resources: Coeur Mining news release dated February 17, 2021																
Production	Proven	814,000							0.195	159.0						
Production	Probable	862,000							0.200	172.0						
Production	Measured	2,390,000							0.233	556.0						
Production	Indicated	1,204,000							0.228	274.0						
Advanced Exploration	Inferred	1,597,000							0.247	394.0						
	Total	**6,867,000**							**0.227**	**1,555.0**						
LMS — Gold veins — Precious metals (gold) Source: NI 43-101 Technical Report on the LMS Gold Project, Goodpaster Mining District, Alaska; 43-101 technical report dated February 19, 2016																
Exploration (0.5 g/t Au cut-off, open pit)	Inferred	9,170,000							0.029	267.0						
POGO — Gold veins — Precious metals (gold) Source: Northern Star Resources Limited news release dated May 3, 2021																
Production (as of March 3, 2021; includes Probable reserves)	Indicated	14,180,116							0.277	3,949						
Production (as of March 3, 2021)	Inferred	11,059,476							0.266	2,951						
	Total	**25,239,592**							**0.272**	**6,900**						
TERRA — Gold veins — Precious metals (gold, silver) Source: Technical Report on Resources, Terra Gold Project, McGrath District, Alaska; 43-101 technical report dated February 19, 2013																
Exploration (5 g/tonne Au cut-off)	Indicated	128,913							0.386	49.8	0.87	112.7				
Exploration (5 g/tonne Au cut-off)	Inferred	811,286							0.456	369.8	0.81	653.9				
	Total	**940,199**							**0.446**	**419.6**	**0.82**	**766.6**				
HERBERT GOLD — Gold veins — Precious metals (gold) Source: Grande Portage Resources Ltd. news release dated May 21, 2021																
Exploration (0.088 ounce of gold per ton cut-off)	Indicated	4,009,101							0.299	1,196.8	0.17	686.7				
Exploration (0.088 ounce of gold per ton cut-off)	Inferred	1,254,429							0.260	325.9	0.14	169.3				
	Total	**5,263,530**							**0.290**	**1,522.7**	**0.16**	**856.0**				
GOLDEN ZONE — Gold veins — Precious metals (gold, silver) Source: Technical Report on the Golden Zone Property, Valdez Creek Mining District, Central Alaska Range, South-Central Alaska; NI 43-101 technical report dated November 23, 2016 / amended August 17, 2017																
Exploration (0.5 g/tonne Au cut-off)	Indicated	4,615,377							0.058	267.4	0.303	1,397.8				
Exploration (0.5 g/tonne Au cut-off)	Inferred	1,491,427							0.024	35.9	0.075	111.4				
	Total	**6,106,804**							**0.050**	**303.3**	**0.247**	**1,509.2**				
LUCKY SHOT (Willow) — Gold veins — Precious metals (gold) Source: Preliminary Feasibility Study for the Lucky Shot Project, Matanuska-Susitna Borough, Alaska, USA; NI 43-101 technical report dated June 30, 2016																
Development (7 g/tonne cut-off; subset of measured)	Proven	75,728							0.551	41.7	0.059	4.5				
Development (7 g/tonne cut-off; subset of indicated)	Probable	116,513							0.394	45.8	0.041	4.8				
Exploration (5 g/tonne Au cut-off)	Measured	63,823							0.782	49.9	0.073	4.7				
Exploration (5 g/tonne Au cut-off)	Indicated	163,802							0.438	71.6	0.047	7.4				
Exploration (5 g/tonne Au cut-off)	Inferred	65,036							0.540	35.1	0.044	2.9				
	Total (resources only)	**292,661**							**0.536**	**156.6**	**0.052**	**15.0**				

APPENDIX D, CONTINUED

Identified mineral resources of Alaska deposits

DEPOSIT—Type—Metal Suite														
Phase	Category	Short Tons of Resource	Cu %	Cu thousand pounds	Pb %	Pb thousand pounds	Zn %	Zn thousand pounds	Au oz/ton	Au thousand ounces	Ag oz/ton	Ag thousand ounces	Mo %	Mo thousand pounds	Other grade	Other quantity
SHOTGUN — Gold veins — Precious metals (gold) Source: Technical Report on the Shotgun Gold Project, Southwest Alaska; NI 43-101 technical report dated May 27, 2013																
Exploration (0.015 ounce of Au/ton cut-off)	Inferred	22,860,000							0.031	706.0						
	Total	**22,860,000**							**0.031**	**706.0**						
DONLIN — Intrusion gold — Precious metals (gold) Source: NovaGold Resources, Inc. Donlin Creek Gold Project, Alaska, USA, NI 43-101 Technical Report on Second Updated Feasibility Study; dated November 18, 2011, amended January 20, 2012																
Development	Proven	8,468,971							0.068	573.0						
Development	Probable	547,984,194							0.061	33,276.0						
Development	Measured	52,910							0.074	53.0						
Development	Indicated	40,210,802							0.065	5,104.0						
Development	Inferred	101,649,697							0.059	5,993.0						
	Total	**698,366,574**							**0.061**	**45,000.0**						
FORT KNOX — Intrusion gold — Precious metals (gold) Source: Kinross Gold Corp. news release dated February 10, 2021																
Production	Proven	40,168,176							0.012	425						
Production	Probable	213,379,658							0.009	2,046						
Production	Measured	14,876,776							0.006	103						
Production	Indicated	279,462,040							0.009	2,486						
Production	Inferred	141,222,446							0.009	1,057						
	Total	**689,109,097**							**0.009**	**6,117**						
GIL — Intrusion gold — Precious metals (gold) Source: Fort Knox Mine, Fairbanks North Star Borough, Alaska, USA; NI 43-101 technical report dated June 11, 2018; effective date: December 31, 2017																
Exploration	Indicated	32,535,782							0.016	533.0						
Exploration	Inferred	4,438							0.014	63.0						
	Total	**32,540,220**							**0.016**	**596.0**						
GOLDEN SUMMIT — Intrusion gold – Precious metals (gold) Source: Golden Summit Project Preliminary Economic Assessment, Fairbanks North Star Borough, Alaska, USA; 43-101 technical report dated January 20, 2016																
Exploration (Dolphin oxide deposit; 0.30 g/tonne cut-off)	Indicated	17,835,214							0.019	345.0						
Exploration (Dolphin oxide deposit; 0.30 g/tonne cut-off)	Inferred	10,604,126							0.017	183.0						
Exploration (Dolphin sulfide deposit; 0.30 g/tonne cut-off)	Indicated	49,912,144							0.020	1,018.0						
Exploration (Dolphin sulfide deposit; 0.30 g/tonne cut-off)	Inferred	68,210,324							0.020	1,401.0						
	Total	**146,561,808**							**0.020**	**2,947.0**						
GRANT MINE (Ester Dome) - Intrusion gold - Precious metals (gold) Source: Technical Report on Ester Dome mineral resource estimation and Eagle Creek results, Fairbanks Mining District, Alaska; NI 43-101 technical report dated July 31, 2008																
Exploration	Indicated	613,600							0.210	126.7						
	Inferred	2,553,400							0.080	214.1						
	Total	**3,167,000**							**0.105**	**340.8**						

APPENDIX D, CONTINUED

Identified mineral resources of Alaska deposits

DEPOSIT—Type—Metal Suite															
Phase	Category	Short Tons of Resource	Cu %	Cu thousand pounds	Pb %	Pb thousand pounds	Zn %	Zn thousand pounds	Au oz/ton	Au thousand ounces	Ag oz/ton	Ag thousand ounces	Mo %	Mo thousand pounds	Other grade	Other quantity
MONEY KNOB (Livengood) — Intrusion gold — Precious metals (gold) Source: Pre-Feasibility Study of the Livengood Gold Project, Livengood, Alaska, USA; 43-101 technical report dated March 8, 2017																
Advanced Exploration	Proven	416,287,867							0.021	8,620.0						
Advanced Exploration	Probable	15,443,381							0.021	353.0						
Advanced Exploration	Measured	131,935,640							0.020	2,220.8						
Advanced Exploration	Indicated	15,465,428							0.020	267.3						
Advanced Exploration	Inferred	58,202,037							0.019	1,127.2						
	Total	**637,334,353**							**0.020**	**12,588.4**						
NIXON FORK — Intrusion gold (skarn) — Precious metals (gold) Source: Technical Report on the Nixon Fork Mine Project, Medfra Quadrangle, Alaska; NI 43-101 technical report dated February 3, 2012																
Development (past producer; lode, 5 g/tonne cut-off)	Indicated	270,427							0.481	130.0						
Development (past producer; lode, 5 g/tonne cut-off)	Inferred	118,200							0.512	60.5						
Development (past producer; tailings, 5 g/tonne cut-off)	Indicated	101,412							0.230	23.3						
Development (past producer; tailings, 5 g/tonne cut-off)	Inferred	52,910							0.210	11.4						
	Total	**542,949**							**0.414**	**225.2**						
VINASALE — Intrusion gold — Precious metals (gold) Source: Technical Report for the Vinasale Mountain Prospect, McGrath Mining District, Alaska; 43-101 technical report dated March 31, 2013																
Exploration	Indicated	3,760,000							0.043	162.0						
Exploration	Inferred	55,340,000							0.031	1,703.0						
	Total	**59,100,000**							**0.032**	**1,865.0**						
ILLINIOS CREEK — Intrusion gold-silver-copper — Precious metals (gold, silver) Source: Western Alaska Copper and Gold website (https://www.wacg.rocks/projects/illinois-creek/; accessed August 31, 2020)																
Advanced Exploration	Indicated	7,450,000	0.18	26,820					0.030	226.0	1.00	7,500				
Advanced Exploration	Inferred	2,240,000	0.22	9,856					0.031	70.0	1.13	2,500				
	Total	**9,690,000**	**0.19**	**36,676**					**0.031**	**296.0**	**1.03**	**10,000**				
NAOSI — Intrusion gold — Precious metals (gold) Source: Internal resource calculation presented to the American Exploration and Mining Association annual meeting, December 2019																
Oxide (0.0225 oz/ton cut-off)	Inferred	8,695,000							0.079	691.0	1.14	9,902				
Sulfide (0.0140 oz/ton cut-off)	Inferred	6,573,000							0.123	811.0	1.44	9,469				
	Total	**15,268,000**							**0.103**	**1,502.0**	**1**	**19,371**				
KORBEL — Intrusion gold — Precious metals (gold) Source: Nova Minerals Ltd. news release dated October 9, 2020																
Exploration (0.18 g/t cut-off)	Inferred	320,320,224							0.010	3,275.0						
	Total	**320,320,224**							**0.010**	**3,275.0**						

APPENDIX D, CONTINUED

Identified mineral resources of Alaska deposits

DEPOSIT—Type—Metal Suite																
Phase	Category	Short Tons of Resource	Cu %	Cu thousand pounds	Pb %	Pb thousand pounds	Zn %	Zn thousand pounds	Au oz/ton	Au thousand ounces	Ag oz/ton	Ag thousand ounces	Mo %	Mo thousand pounds	Other grade	Other quantity
DELTA — Massive sulfide — Polymetallic (copper, lead, zinc, gold, silver) Source: Bedrock Geologic Map of the Delta Mineral Belt, Tok Mining District, Alaska (DGGS PR 122); 2003																
Exploration (DW/Mid/Nunatak/LP)	Inferred	9,400,000	0.4	75,200	1.75	329,000	4.61	866,680	0.047	441.9	1.85	17,402				
Exploration (PP2)	Inferred	5,900,000	0.4	47,200	2.1	247,800	4.6	542,800	0.050	292.9	2.07	12,232				
Exploration (DDS)	Inferred	2,300,000	1.1	50,600	2.6	119,600	6.5	299,000	0.070	161.2	2.98	6,850				
Exploration (DDN)	Inferred	1,200,000	1.6	38,400	2.4	57,600	2.3	55,200	0.093	112.1	2.98	3,574				
	Total	**18,800,000**	**0.6**	**211,400**	**1.9**	**754,000**	**4.5**	**1,763,680**	**0.048**	**1,008.1**	**1.96**	**40,058**				
RED MOUNTAIN/BONNIFIELD — Massive sulfide — Polymetallic (copper, lead, zinc, gold, silver) Source: Maiden JORC Mineral Resource at White Rock's Red Mountain zinc-silver Project, Alaska; White Rock Minerals Ltd. news release April 26, 2017																
Exploration (Dry Creek; 3% Zn-equivalent cut-off)	Inferred	2,645,547	0.2	11,023	1.9	101,403	4.7	253,532	0.012	32.0	2.01	5,300				
Exploration (West Tundra Flats; 3% Zn-equivalent cut-off)	Inferred	7,385,486	0.1	15,432	2.8	414,469	6.2	917,123	0.032	229.0	5.51	40,800				
	Total	**10,031,033**	**0.1**	**26,455**	**2.6**	**515,872**	**5.8**	**1,170,655**	**0.027**	**261.0**	**4.59**	**46,100**				
GREENS CREEK — Massive sulfide — Polymetallic (lead, zinc, gold, silver) Source: Hecla Mining Company 2020 Annual Report																
Production	Proven	3,000			3.70	240	7.80	500	0.100	0.3	21.80	70				
Production	Probable	8,975,000			2.80	509,680	7.30	1,304,340	0.090	827.0	12.40	111,333				
Production	Measured	297,000			3.10	18,620	10.30	61,000	0.110	33.0	12.90	3,837				
Production	Indicated	8,599,000			3.00	513,580	8.20	1,417,040	0.100	848.0	12.90	110,844				
Production	Inferred	1,767,000			2.80	99,340	7.00	246,960	0.080	145.0	13.20	23,370				
	Total	**19,641,000**			**2.89**	**1,141,460**	**7.71**	**3,029,840**	**0.094**	**1,853.3**	**12.70**	**249,454**				
NIBLACK — Massive sulfide — Polymetallic (copper, zinc, gold, silver) Source: Mineral Resource Estimation, Niblack Polymetallic Sulfide Project, Alaska, U.S.A.; technical report dated December 5, 2011																
Advanced Exploration (Lookout deposit)	Indicated	6,215,000	0.95	118,085			1.73	215,039	0.051	318.0	0.86	5,357				
Advanced Exploration (Lookout deposit)	Inferred	2,612,000	0.73	38,135			1.17	61,121	0.041	108.0	0.63	1,650				
Advanced Exploration (Trio deposit)	Inferred	1,128,000	1.00	22,560			1.56	35,194	0.032	37.0	0.48	545				
	Total	**9,955,000**	**0.81**	**178,780**			**1.29**	**311,354**	**0.039**	**384.0**	**0.59**	**5,843**				
PALMER — Massive sulfide — Polymetallic (copper, zinc, gold, silver) Source: NI 43-101 Technical Report and Updated Resource Estimate to include the AG Zone for the Palmer Exploration Project, Porcupine Mining District, Southeast Alaska, USA; effective date: December 18, 2018																
															Barite (%)	**Thousands of pounds**
Exploration (RW & South Wall Zones; $75/tonne cut-off)	Indicated	5,155,504	1.49	154,000			5.23	539,000	0.009	45.1	0.899	4,600			23.9	2,464,765
Exploration (RW & South Wall Zones; $75/tonne cut-off)	Inferred	5,884,131	0.96	113,000			5.20	612,000	0.008	48.1	0.853	5,000			22.0	2,588,224
Exploration (AG Zone; 5.0% zinc-equivalent cut-off)	Inferred	4,691,431	0.12	11,000	0.96	90,000	4.64	435,000	0.016	72.5	3.489	16,400			34.8	3,262,838
	Total	**15,731,066**	**0.9**	**278,000**	**0.3**	**90,000**	**5.04**	**1,586,000**	**0.011**	**166**	**1.65**	**26,000**			**26.4**	**8,315,827**

APPENDIX D, CONTINUED

Identified mineral resources of Alaska deposits

DEPOSIT—Type—Metal Suite																
Phase	Category	Short Tons of Resource	Cu %	Cu thousand pounds	Pb %	Pb thousand pounds	Zn %	Zn thousand pounds	Au oz/ton	Au thousand ounces	Ag oz/ton	Ag thousand ounces	Mo %	Mo thousand pounds	Other grade	Other quantity
JOHNSON TRACT — Massive sulfide — Polymetallic (copper, lead, zinc, gold, silver) Source: Initial Mineral Resource Estimate for the Johnson Tract Project, Alaska; 43-101 technical report dated April 29, 2020																
Exploration (4.0 g/t gold-equivalent cutoff)	Indicated	2,353,432	0.57	26,800	0.80	37,600	5.85	275,300	0.177	417.0	0.17	397				
Exploration (4.0 g/t gold-equivalent cutoff)	Inferred	640,442	0.54	6,900	0.33	4,200	6.67	85,500	0.060	38.0	0.25	162				
	Total	**2,993,874**	**0.56**	**33,700**	**0.70**	**41,800**	**6.03**	**360,800**	**0.152**	**455.0**	**0.19**	**559**				
RED DOG — Massive sulfide — Base metals (lead, zinc, silver) Source: Reserves and resouces as of December 31, 2020. https://www.teck.com/investors/reserves-&-resources, accessed on September 20, 2021																
Production (Aqqaluk, Qanaiyaq)	Probable	50,706,260			3.6	1,829,835	12.9	10,846,730			1.97	62,810				
Production (Aqqaluk, Qanaiyaq)	Indicated	9,369,635			5.3	993,181	7.7	1,442,924			2.69	25,171				
Production (Aqqaluk, Qanaiyaq)	Inferred	10,031,021			4.5	902,792	12.5	2,507,755			2.58	25,864				
	Total	**70,106,916**			**4.0**	**3,725,808**	**12.1**	**14,797,409**			**2.15**	**113,844**				
ANARRAAQ — Massive sulfide — Base metals (lead, zinc, silver) Source: NI 43-101 Technical Report, Red Dog Mine, Alaska, USA; report dated February 21, 2017																
Exploration	Inferred	21,428,906			4.2	1,800,028	14.4	6,171,525			2.13	45,626				
ANARRAAQ — Bedded Barite: Source: King et al., 2002, A summary of ongoing research in the Red Dog district and possible applications to exploration, in Large et al., eds.: Stratiform Zn-Pb-Ag Deposits and Geological Environments, with Emphasis on the Aust. and N. Am. Giants: SEG/PDAC Workshop, Toronto, 2002, 6 p.																
															Barite (%)	**Thousands of pounds**
Exploration (barite grade unspecified)	Inferred	1,100,000,000													?	?
LIK — Massive sulfide — Base metals (lead, zinc, silver) Source: Preliminary Economic Assessment Technical Report, Zazu Metals Corporation, Lik Deposit, Alaska; dated April 23, 2014																
Advanced Exploration (Lik South, in pit, 5% Zn+Pb cut-off)	Indicated	18,570,000			2.70	1,003,000	8.04	2,986,000			1.463	27,170				
Advanced Exploration (Lik North, in pit, 5% Zn+Pb cut-off)	Indicated	490,000			2.77	27,000	10.03	98,000			1.723	840				
Advanced Exploration (Lik South, other, 7% Zn+Pb cut-off)	Indicated	760,000			3.15	48,000	8.04	122,000			1.489	1,130				
Advanced Exploration (Lik North, other, 7% Zn+Pb cut-off)	Indicated	140,000			2.93	8,000	8.93	25,000			1.095	150				
Advanced Exploration (Lik South, in pit, 5% Zn+Pb cut-off)	Inferred	820,000			1.94	32,000	7.73	127,000			0.391	320				
Advanced Exploration (Lik North, in pit, 5% Zn+Pb cut-off)	Inferred	2,350,000			2.94	138,000	8.88	417,000			1.337	3,140				
Advanced Exploration (Lik South, other, 7% Zn+Pb cut-off)	Inferred	560,000			1.59	18,000	6.97	78,000			0.330	180				
Advanced Exploration (Lik North, other, 7% Zn+Pb cut-off)	Inferred	2,160,000			2.99	129,000	9.22	398,000			1.337	2,890				
	Total	**25,850,000**			**2.72**	**1,403,000**	**8.23**	**4,251,000**			**1.163**	**35,820**				

APPENDIX D, CONTINUED

Identified mineral resources of Alaska deposits

DEPOSIT—Type—Metal Suite																
Phase	Category	Short Tons of Resource	Cu %	Cu thousand pounds	Pb %	Pb thousand pounds	Zn %	Zn thousand pounds	Au oz/ton	Au thousand ounces	Ag oz/ton	Ag thousand ounces	Mo %	Mo thousand pounds	Other grade	Other quantity
ARCTIC — Massive sulfide — Polymetallic (copper, lead, zinc, gold, silver) Source: Arctic Feasibility Study, Alaska, USA, NI 43-101 Technical Report; dated August 20, 2020																
Advanced Exploration (in pit, 0.5% Cu-equivalent cut off)	Probable	47,887,653	2.24	2,145,367	0.54	517,187	3.12	2,988,190	0.014	657.2	1.01	48,522				
Advanced Exploration (in pit, 0.5% Cu-equivalent cut off)	Inferred	3,858,085	1.71	131,000	0.60	47,000	2.72	210,000	0.011	40.0	0.84	3,000				
	Total	**51,745,738**	**2.20**	**2,276,367**	**0.54**	**564,187**	**3.09**	**3,198,190**	**0.013**	**697.2**	**1.00**	**51,522**				
BORNITE — Massive sulfide — Polymetallic (carbonate-hosted copper, cobalt) Source: NI 43-101 Technical Report on the Bornite Project, Northwest Alaska, USA; report dated June 5, 2018																
															Co (%)	**Thousands of pounds**
Exploration (in pit, 0.5% Cu cut-off)	Indicated	44,643,555	1.02	913,000												
Exploration (in pit, 0.5% Cu cut-off)	Inferred	92,704,271	0.95	1,768,000											0.017	45,000
Exploration (below pit, 1.5% Cu cut-off)	Inferred	63,713,518	2.89	3,683,000											0.025	32,000
	Total	**201,061,344**	**1.58**	**6,364,000**											**0.020**	**77,000**
SUN — Massive sulfide — Polymetallic (copper, lead, zinc, gold, silver) Source: Valhalla Metals Inc. news release August 22, 2018																
Exploration ($75/tonne cut-off)	Indicated	1,888,257	1.48	55,846	1.11	42,035	4.32	162,962	0.006	12.0	1.75	3,307				
Exploration ($75/tonne cut-off)	Inferred	9,940,632	1.21	239,643	1.46	290,258	4.18	831,334	0.007	73.0	2.39	23,681				
	Total	**11,828,889**	**1.25**	**295,489**	**1.40**	**332,293**	**4.20**	**994,296**	**0.007**	**85**	**2.28**	**26,988**				
SMUCKER — Massive sulfide — Polymetallic (copper, lead, zinc, gold, silver) Source: Historical resource from Anaconda Copper Mining Company, Internal Report, 1981; cited in Trilogy Metals news release dated March 19, 2019																
Exploration	Inferred	12,786,796	0.95	242,949	2.3	588,193	6.4	1,636,710	0.025	324.8	4.78	61,084				
HORSE CREEK — Massive sulfide — Polymetallic (copper, lead, zinc, silver) Source: Historical resource from Kennecott Mines Company, Internal Report, 1985; cited in Trilogy Metals news release dated March 19, 2019																
Exploration	Historic	11,000,000	1.00	220,000	2	440,000	3	660,000			0.91	9,957				
SUNSHINE — Massive sulfide — Polymetallic (copper, lead, zinc, silver) Source: Historical resource from Kennecott Mines Company, Internal Report, 1997; cited in Trilogy Metals news release dated March 19, 2019																
Exploration	Inferred	22,000,000	1.40	616,000	0.5	220,000	2.5	1,100,000			0.76	16,767				
SHUNGNAK — Massive sulfide — Polymetallic (copper, zinc, silver) Source: Historical resource from Bear Creek Mining Company, Internal Report, 1983; cited in Trilogy Metals news release dated March 19, 2019																
Exploration	Inferred	1,100,000	3.00	66,000			2	44,000			1.82	1,998				
BT — Massive sulfide — Polymetallic (copper, lead, zinc, silver) Source: Historical resource from Kennecott Mines Company, Internal Report, 1997; cited in Trilogy Metals news release dated March 19, 2019																
Exploration	Inferred	3,800,000	1.70	129,200	0.9	68,400	2.6	197,600			1.18	4,483				
CARIBOU DOME — Sediment-hosted — Base metals (copper) Source: High-Grade Initial JORC Resource Estimate -- Caribou Dome; Coventry Resources news release dated April 5, 2017																
Advanced Exploration (0.5% Cu cut-off)	Measured	627,214	3.6	46,297												
Advanced Exploration (0.5% Cu cut-off)	Indicated	653,670	2.2	28,660												
Advanced Exploration (0.5% Cu cut-off)	Inferred	1,801,175	3.2	114,639												
	Total	**3,082,059**	**3.1**	**189,596**												

APPENDIX D, CONTINUED

Identified mineral resources of Alaska deposits

DEPOSIT—Type—Metal Suite																
Phase	Category	Short Tons of Resource	Cu %	Cu thousand pounds	Pb %	Pb thousand pounds	Zn %	Zn thousand pounds	Au oz/ton	Au thousand ounces	Ag oz/ton	Ag thousand ounces	Mo %	Mo thousand pounds	Other grade	Other quantity
PEBBLE — Porphyry — Polymetallic (copper, gold, silver, molybdenum) Source: 2020 Technical Report on the Pebble Project, Southwest Alaska, USA; August 18, 2020															Re (ppm)	Thousands of pounds
Advanced Exploration (0.3 CuEq cut-off)	Measured	580,912,100	0.33	3,830,000					0.010	5,930	0.050	28,100	0.0178	210,000	0.32	368
Advanced Exploration (0.3 CuEq cut-off)	Indicated	6,535,536,700	0.41	53,580,000					0.010	64,810	0.050	316,400	0.0246	3,200,000	0.41	5,386
Advanced Exploration (0.3 CuEq cut-off)	Inferred	4,909,644,200	0.25	24,540,000					0.007	35,800	0.035	170,400	0.0226	2,180,000	0.36	3,534
	Total	**12,026,093,000**	**0.341**	**81,950,000**					**0.009**	**106,540**	**0.044**	**514,900**	**0.0235**	**5,590,000**	**0.39**	**9,288**
PYRAMID — Porphyry — Polymetallic (copper, gold, molybdenum) Source: NI 43-101 Technical Report for the Pyramid Project, Alaska Peninsula, Alaska; report dated January 2018																
Main Zone (0.20% Cu-equivalent cut-off)	Inferred	155,315,479	0.38	1,186,000					0.003	442.0			0.022	68,000		
West Zone (0.20% Cu-equivalent cut-off)	Inferred	13,778,875	0.28	76,000					0.002	14.0			0.010	2,000		
	Total	**169,094,354**	**0.37**	**1,262,000**					**0.003**	**456.0**			**0.021**	**70,000**		
SHUMAGIN (UNGA PROJECT)— Epithermal — Precious metals (gold, silver) Source: Redstar Gold Corp. news release dated February 10, 2020																
Exploration (3.5 g/t cut-off)	Inferred	954,617							0.403	384.3	1.034	986.3				
CENTENNIAL (UNGA PROJECT)— Epithermal — Precious metals (gold, silver) Source: Historical resource estimate by Battle Mountain Gold Company (1989), cited in Redstar Resources technical report on the Unga project, Southwest Alaska, USA; report dated June 14, 2018																
Exploration	Inferred	4,780,000							0.042	200.0						
TETLIN — Main and North Peak Skarn — Polymetallic (copper, gold, silver) Source: Royal Gold news release dated September 24, 2018																
Exploration (0.74, 0.66 g/tonne Au-equiv. cut-off: Main, North)	Measured	521,393	0.148	1,500					0.187	97.1	0.488	254.0				
Exploration (0.74, 0.66 g/tonne Au-equiv. cut-off: Main, North)	Indicated	9,620,962	0.153	29,500					0.116	1,110.9	0.411	3,944.8				
Exploration (0.5 g/tonne Au-equivalent cut-off?)	Inferred	1,481,505	0.151	31,000					0.079	116.4	0.469	694.1				
	Total	**11,623,859**	**0.153**	**62,000**					**0.114**	**1,324.4**	**0.421**	**4,892.9**				
RAINTREE WEST — Porphyry — Polymetallic (copper, gold, silver) Source: NI 43-101 Resource Estimate for the Whistler Project; report dated March 24, 2016																
Exploration (0.3 g/tonne Au-equivalent cut-off)	Inferred (above 250m)	34,921,181	0.06	41,910					0.012	409.0	0.157	5,490				
Exploration (0.3 g/tonne Au-equivalent cut-off)	Inferred (below 100m)	57,055,566	0.10	114,130					0.020	1,130.0	0.109	6,224				
	Total	**91,976,746**	**0.08**	**156,040**					**0.017**	**1,539.0**	**0.127**	**12,544**				
ISLAND MOUNTAIN — Porphyry — Polymetallic (copper, gold, silver) Source: NI 43-101 Resource Estimate for the Whistler Project; report dated March 24, 2016																
Exploration (0.3 g/tonne Au-equivalent cut-off)	Indicated	34,259,795	0.06	41,120					0.014	485.0	0.032	1,099				
Exploration (0.3 g/tonne Au-equivalent cut-off)	Inferred	90,411,466	0.05	90,430					0.014	1,237.0	0.030	2,690				
	Total	**124,671,261**	**0.05**	**131,550**					**0.014**	**1,722.0**	**0.030**	**3,789**				

APPENDIX D, CONTINUED

Identified mineral resources of Alaska deposits

DEPOSIT—Type—Metal Suite																
Phase	Category	Short Tons of Resource	Cu %	Cu thousand pounds	Pb %	Pb thousand pounds	Zn %	Zn thousand pounds	Au oz/ton	Au thousand ounces	Ag oz/ton	Ag thousand ounces	Mo %	Mo thousand pounds	Other grade	Other quantity
WHISTLER — Porphyry — Polymetallic (copper, gold, silver) Source: NI 43-101 Resource Estimate for the Whistler Project; report dated March 24, 2016																
Exploration (Pit-constrained; $7.50/tonne cut-off)	Indicated	87,300,000	0.17	302,000					0.015	1,280.0	0.057	5,030				
Exploration (Pit-constrained; $7.50/tonne cut-off)	Inferred	160,700,000	0.15	467,000					0.012	1,850.0	0.051	8,210				
	Total	**248,000,000**	**0.16**	**769,000**					**0.013**	**3,130.0**	**0.053**	**13,240.0**				
ZACKLY — Skarn — Polymetallic (copper, gold) Source: JORC-compliant resource, PolarX news release dated March 20, 2018																
Exploration	Inferred	3,747,854	1.2	90,900					0.058	213	0.409	1,500				
QUARTZ HILL — Porphyry — (Molybdenum) Source: Mineral investigations in the Ketchikan mining district, southeastern Alaska: U.S. Bureau of Mines Open-File Report 11-95 (1995)																
Exploration	"Probable resource"	444,000,000											0.219	978,851,280		
Exploration	"Possible resource"	1,360,000,000											0.136	2,998,283,200		
	Total	**1,804,000,000**											**0.156**	**3,977,134,480**		
BOKAN MOUNTAIN — Other (Intrusion hosted) — Other (rare-earth elements) Source: Ucore Increases Resource at Bokan Dotson-Ridge; Ucore Rare Metals news release May 11, 2015																
															TREO (%)	**Thousands of pounds**
Advanced Exploration (Dotson trend, 0.4% TREO cut-off)	Indicated	5,278,000													0.602	63,544
Advanced Exploration (Dotson trend, 0.4% TREO cut-off)	Inferred	1,157,000													0.603	13,959
	Total	**6,435,000**													**0.602**	**77,503**
GRAPHITE CREEK — Other (graphite) Source: Graphite One news release dated May 26, 2019																
															Graph-ite (%)	**Thousands of pounds**
Exploration (5.0% Cg cut-off)	Measured	1,860,000													8.0	298,001
Exploration (5.0% Cg cut-off)	Indicated	10,200,000													7.7	1,577,104
Exploration (5.0% Cg cut-off)	Inferred	101,300,000													8.0	16,188,267
	Total	**113,360,000**													**8.0**	**18,063,372**
LAKEVIEW, LONGVIEW — Other (stratiform barite) Source: Schmidt and others, 2009, The Longview/Lakeview barite deposits, southern National Petroleum Reserve, Alaska; potential-field models and preliminary size estimates, U.S. Geological Survey Professional Paper 1760-C, 29 p. [http://pubs.usgs.gov/pp/1760/c/]																
															Barite (%)	**Thousands of pounds**
USGS geological/geophyiscal estimate (range 4.5-38.4 million metric tons; mid-range value: 18.4 million metric tons)	Inferred	20,200,000													93	37,600,000
BION — Other (stratiform barite) Source: Kelley and others, 1993, Barite deposits in the Howard Pass Quadrangle and possible relations to barite elsewhere in the northwestern Brooks Range, Alaska: U.S. Geological Survey Open-File Report 93-215, 13 p. [https://doi.org/10.3133/ofr93215] Geological Survey Professional Paper 1760-C, 29 p. [http://pubs.usgs.gov/pp/1760/c/]																
															Barite (%)	**Thousands of pounds**
USGS, USBM geological/geophyiscal estimate (barite grade unspecified)	Inferred	11,079,331													?	?

APPENDIX E
Conversion Chart, U.S. Customary Units/Metric Units

Weight/Mass/Ore Content		
To convert from:	**to:**	**multiply by:**
ounces (avoirdupois)	grams	28.3495
ounces (troy)	grams	31.1035
pounds	kilograms	0.4536
short tons	metric tons (tonnes)	0.9072
grams	ounces (avoirdupois)	0.03527
grams	ounces (troy)	0.03215
kilograms	pounds	2.20462
metric tons (tonnes)	short tons	1.10231
parts per million (ppm)	parts per billion (ppb)	1,000
parts per million (ppm)	ounces per ton	0.0292
parts per million (ppm)	grams/metric tons (tonnes)	1.00

Area		
To convert from:	**to:**	**multiply by:**
square miles	square kilometers	2.59
square miles	acres	640
acres	square meters	4,046.86
acres	hectares	0.40486
square yards	square meters	0.836127
square feet	square meters	0.092903
square inches	square centimeters	6.4516
square inches	square millimeters	645.16
square meters	acres	0.000247105
square kilometers	acres	247.105
square kilometers	square miles	0.386102
square meters	square feet	10.7639
square meters	square yards	1.19599
hectares	acres	2.47105
hectares	square meters	10,000
square centimeters	square inches	0.155
square millimeters	square inches	0.00155

APPENDIX E, CONTINUED

Conversion Chart, U.S. Customary Units/Metric Units

Length		
To convert from:	**to:**	**multiply by:**
miles	kilometers	1.60934
miles	yards	1,760
miles	meters	1,609.34
yards	meters	0.9144
feet	meters	0.3048
feet	centimeters	30.48
feet	millimeters	304.8
inches	centimeters	2.54
inches	millimeters	25.4
kilometers	miles	0.621371
meters	yards	1.09361
meters	feet	3.28084
millimeters	feet	0.00328
millimeters	inches	0.03937
centimeters	inches	0.3937

Volume		
To convert from:	**to:**	**multiply by:**
cubic yards	cubic meters	0.764555
cubic feet	cubic meters	0.0283168
cubic inches	cubic centimeter	16.3871
cubic meters	cubic yards	1.30795
cubic meters	cubic feet	35.3147
cubic centimeters	cubic inches	0.0610237
gallons (U.S.)	liters	3.78541
liters	gallons (U.S.)	0.264172
milliliters	ounces (fluid)	0.033814
ounces (fluid)	milliliters	29.5735

Temperature		
To convert from:	**to:**	**do this:**
degrees Fahrenheit	degrees Celsius	subtract 32, multiply by 5, divide by 9
degrees Celsius	degrees Fahrenheit	multiply by 9, divide by 5, add 32

Source: google.com unit converter.

	Mining districts[a]	Production (in refined troy ounces) Total	Placer	Lode
1	Lisburne district	0	0	0
2	Noatak district	7,800	7,800	0
3	Wainwright district	0	0	0
4	Barrow district	0	0	0
5	Colville district	0	0	0
6	Canning district	0	0	0
7	Sheenjek district	0	0	0
8	Chandalar district	70,278	52,878	17,400
9	Koyukuk district	378,075	378,075	0
10	Shungnak district	15,000	15,000	0
11	Kiana & Selawik districts	40,607	40,607	0
12	Fairhaven district (Candle subdistrict)	254,265	254,265	0
13	Fairhaven district (Inmachuk subdistrict)	349,975	349,975	0
14	Serpentine district	4,536	4,536	0
15	Port Clarence district	42,358	42,358	0
16	Kougarok district	191,712	191,712	0
17	Nome (Cape Nome) district	5,043,465	5,043,465	0
18	Council district	1,047,042	1,020,042	27,000
19	Koyuk district	84,462	84,462	0
20	Hughes district	403,671	403,671	0
21	Kaiyuh district	149,703	5,400	144,303
22	Anvik district	7	7	0
23	Marshall district	124,506	124,506	0
24	Bethel district	42,953	42,953	0
25	Goodnews Bay district	31,202	31,202	0
26	Aniak district	613,407	613,407	0
27	Iditarod district	1,565,226	1,562,296	2,930
28	McGrath district	364,672	133,307	231,365
29	Innoko district	757,219	757,063	156
30	Ruby district	478,023	478,023	0
31	Kantishna district	99,307	91,401	7,906
32	Hot Springs district	604,926	604,926	0
33	Melozitna district	14,630	14,630	0
34	Rampart district	204,845	204,845	0
35	Tolovana district	547,556	547,556	0
36	Yukon Flats district	0	0	0
37	Circle district	1,125,341	1,125,341	0
38	Black district	2	2	0
39	Eagle district	52,166	52,166	0
40	Fortymile district	602,758	602,758	0
41	Chisana district	144,521	78,021	66,500
42	Tok district	288	288	0
43	Goodpaster district	4,256,781	2,051	4,254,730
44	Fairbanks district	16,863,096	8,282,595	8,580,501
45	Bonnifield district	108,983	102,283	6,700
46	Richardson subdistrict of Fairbanks district[b]	121,828	119,528	2,300
47	Delta River district	11,732	11,732	0
48	Chistochina district	186,604	186,604	0
49	Valdez Creek district	533,167	531,586	1,581
50	Yentna district	204,980	204,980	0
51	Redoubt district	105	105	0
52	Bristol Bay Region	1,570	1,570	0
53	Kodiak district (53b)–Alaska Peninsula Region (53a)	112,409	4,809	107,600
54	Homer district	17	17	0
55	Hope & Seward districts	135,252	70,252	65,000
56	Anchorage district[c]	460	460	0
57	Willow Creek district	667,841	58,841	609,000
58	Prince William Sound district	137,802	102	137,700
59	Nelchina district	15,016	15,016	0
60	Nizina district	148,500	148,500	0
61	Yakataga district	18,041	18,041	0
62	Yakutat district[d]	13,200	2,200	11,000
63	Juneau district (partial)	82,540	82,540	0
64	Juneau (64a) & Admiralty (64b) districts	10,775,121	82,390	10,692,731
65	Chichagof district	770,000	0	770,000
66	Petersburg district	15,000	15,000	0
67	Kupreanof district	0	0	0
68	Hyder district	219	219	0
69	Ketchikan district	62,002	4,002	58,000
70	Bering Sea Region	0	0	0
71	Aleutian Islands Region	0	0	0
	Unknown (undistributed)[e]	306,932	303,738	3,194
	TOTAL (refined Troy ounces)	**51,005,701**	**25,208,104**	**25,797,597**
	(1,586 metric tons)			

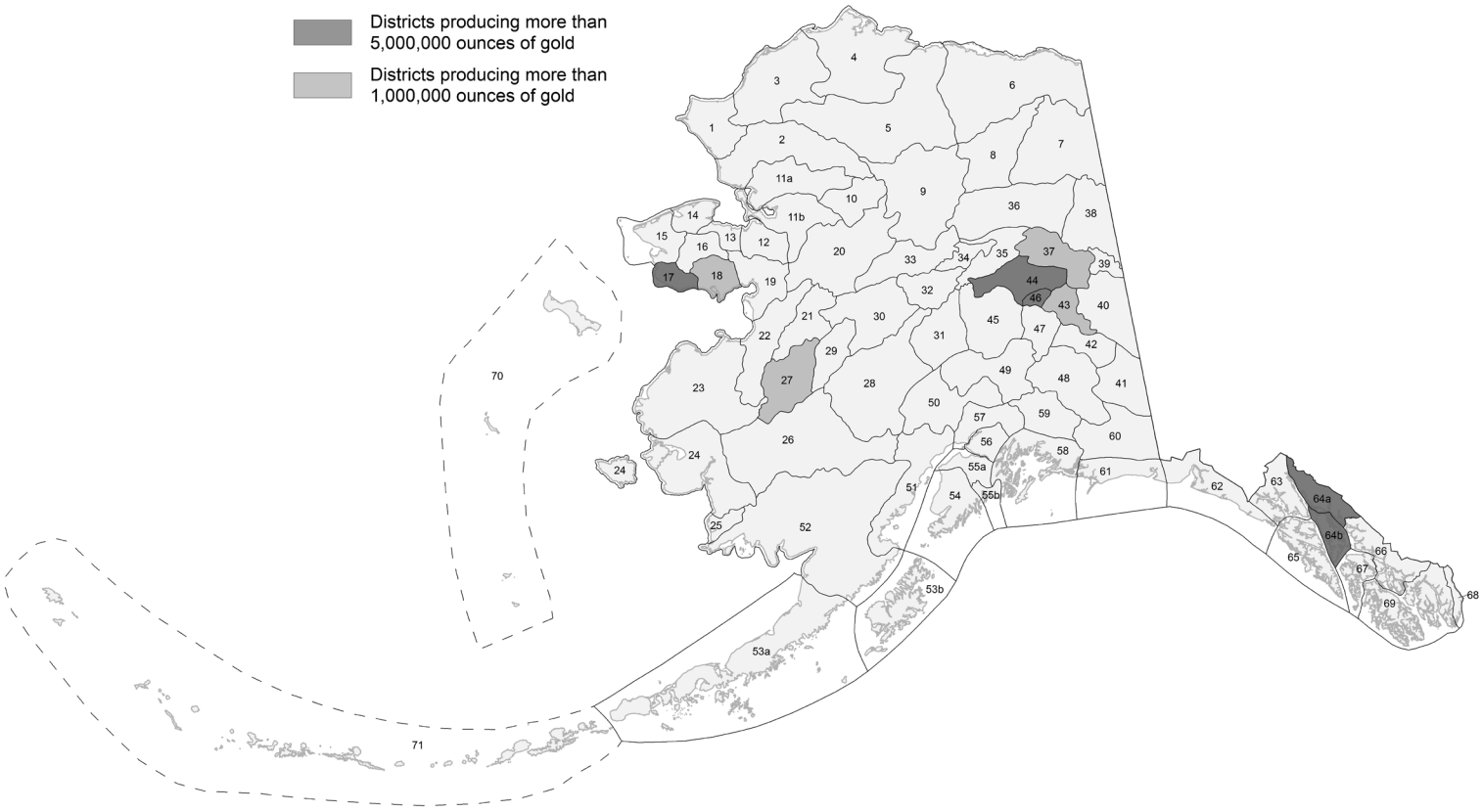
[a]Mining district names and boundaries revised slightly from those defined by Ransome and Kerns (1954) and Cobb (1973). Sources of data: U.S. Geological Survey, U.S. Bureau of Mines, and Alaska Territorial Department of Mines records 1880–1930; U.S. Mint records 1930–1969; State of Alaska production records 1970–2020. Entries of "0" generally mean no specific records are available.

[b]Not included in total for Fairbanks district.

[c]Most placer gold production included in Willow Creek district.

[d]Includes lode production from Glacier Bay area and placer production from Lituya Bay area.

[e]Production that cannot be credited to individual districts due to lack of specific records or for reasons of confidentiality. Beginning in 2015, placer production is not compiled for individual mining districts, but is instead included in the 'Unknown' category.


Districts producing more than 5,000,000 ounces of gold
Districts producing more than 1,000,000 ounces of gold
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64b
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