STATE OF ALASKA

Department of Natural Resources

Division of Geological & Geophysical Surveys

230 So. Franklin St. Juneau 99801* | 323 E. 4th Ave. Anchorage, AK 99501* | 3001 Porcupine Dr. Anchorage 99501 | P.O. Box 80007 College 99708*+ | P.O. Box 7438 Ketchikan 99901*

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Madhatters of the Kuskokwim quicksilver mines

By T.K. Bundtzen and C.N. Conwell

Mercury, or 'quicksilver,' is unique; it is liquid at room temperature, high in density and surface tension, and electrically conductive. The silvery-white metal alloys readily, is chemically stable, and forms toxic compounds.

Cinnabar, the principal ore of mercury, is found in Alaskan mineral belts ranging from the Wrangell Mountains to Nome, but the principal deposits occur in the Kuskokwim mercury province, a 400-mile-long belt that stretches from Manley Hot Springs to Goodnews Bay (fig. 1). Over two dozen deposits have been located since the turn of the 20th century; 12 of these have produced 41,000 or more 76-lb flasks of mercury.

There was a continuous output from Alaskan mercury mines for 3-1/2 decades (1940-74). The principal producer was the Red Devil Mine near Sleetmute, but other notable lodes include those at DeCourcy Mountain, Parks, Cinnabar Creek, Red Top, Lucky Day, and White Mountain.

Overall production history (1909-74) is erratic (fig.2); highs were reached during World War II, the 1950's, and the early 1970's. Alaska's deposits accounted for up to one-fifth of U.S. domestic requirements during these periods. Dedicated small operators such as R.F. Lyman, John Murphy, Hans Halverson, Matt DeCourcy, and Russell Schaeffer constituted the backbone of the industry.

Geology of the deposits

Alaskan mercury deposits received extensive government investigations in the 1940's and 1950's because of the metal's strategic importance. The Kuskokwim quicksilver mines were then the only significant lode operations in the territory. Sainsbury and MacKevett (1965) and Cady and others (1955) provide the best geological summaries of lodes and placers.

The mercury deposits consist primarily of fracture fillings in faults that intersect brittle rocks of diverse parentage---including lithic sandstone, shale, granitic rock, limestone, and altered mafic dikes. The dikes, commonly referred to by cinnabar prospectors of the region as 'silica carbonate

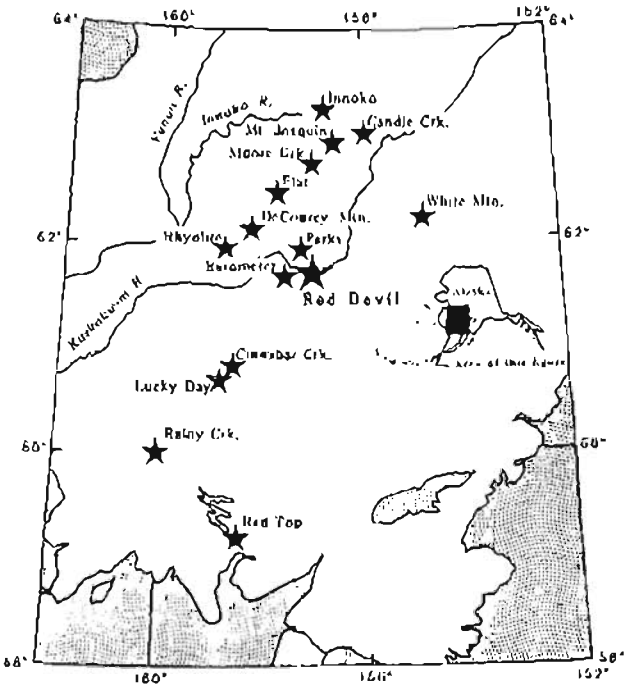

Fig. 1. Kuskokwim mercury province.

rock,' were important to localization of ore in the larger known deposits.

According to Herreid (1965), the Red Devil cinnabar-stibnite lodes are located along a wrench-fault zone at its intersection with two altered basalt dikes. More than 20 plunging chimneylike ore bodies occupy the offset intersection of the dikes and faults. Deposits in the Flat and Mt. Joaquin areas (fig. 1) are associated with large fracture systems near monzonitehornfels contact zones. Although many of the lodes are located in clastic rocks of Cretaceous age, the White Mountain deposits occur in Farewell fault-related fractures that cut dolomitized Ordovician limestone. Most mercury deposits of the region consist of either cinnabar alone or cinnabar and stibnite with gangue minerals; however, the Flat deposits contain tungsten, gold, and arsenic as well. The wide association of altered mafic dikes or granitic intrusives with cinnabar-stibnite lodes suggests a genetic connection between the two.

Sainsbury and MacKevett (1965) believe most lodes were deposited by rising hydrothermal fluids that carried mercury and antimony in solution at the epithermal temperature range. Sulfides were probably deposited when ore fluids reached near-surface ground water; that is, a hot-springs environment. Fluid-inclusion studies of Red Devil ores by Roedder (1963) support this hypothesis and show primary three-phase inclusions with CO_2 homogenation temperatures of 26-31°C.

Many 'quick' deposits are hosted in the Kuskokwim group flysch, which was probably deposited in an elongated structural trough during mid- to Late Cretaceous time. Similar flysch-hosted mercury deposits in California, South America, and Asia probably formed as a result of subduction or rift-related processes near plate boundaries. Thus, mercury originally contained in eugeosynclinal deep-water sediments has been 'distilled' by both the geothermal gradient and igneous activity. Hydrothermal mercury-bearing fluids migrated upward into higher levels and were deposited at favorable structural sites. The 60- to 70-m.y.-old plutons, volcanics, and dike swarms that predominate in the Kuskokwim area (Bundtzen and Laird, 1980) would be logical heat 'engines' that transport and concentrate mercury-antimony fluids into higher level ore deposits.

Exploration methods

Four-fifths of the Kuskokwim Mountains are covered by vegetation and windblown loess, and exploration usually proceeds by indirect methods. Mercury-vapor 'sniffers' and geobotanical methods have been used with some success in the western states, but panning still remains the best prospecting tool for Alaskan cinnabar deposits, even though, according to prospector Hans Halverson, "the creeks draining Red Devil didn't pan."

Cinnabar's specific gravity is 8.05, and it easily concentrates in a gold pan. After finding cinnabar in stream gravels, the valley sides are explored by panning soils from small test pits. Then, when the prospector finds colluvium exceptionally rich in cinnabar, he uses an auger to penetrate the soil (and possibly the bedrock) to locate the cinnabar in place.

Long-hole rotary drilling was successfully used at Red Devil to locate additional ore reserves. Geophysical methods have not been particularly successful, but water-saturated shear zones could be picked up with

conductivity surveys.

Mining history

Cinnabar, not gold, may have been the first ore mineral discovered by the Russians in Alaska, who identified it 21 miles east of Aniak in 1838. However, the Russian-American Company was primarily interested in furs and did not develop their find.

At the turn of the century, prospectors investigating the Iditarod, Innoko, Candle Creek, and Moore Creek areas found cinnabar intimately associated with rich placer-gold deposits. A few flasks of mercury were retorted from cinnabar concentrate and used for amalgam during the early gold-rush years.

Between 1909 and 1940, fracture-controlled lode deposits of cinnabar and stibnite were discovered in the Sleetmute, DeCourcy Mountain, McGrath, Cinnabar Creek, and Dillingham areas. Erratic production amounting to about 800 flasks were retorted from high-grade surface or near-surface ores and used locally. The Red Devil deposit was discovered by accident in 1933, when a 10-year-old berrypicker found pieces of high-grade cinnabar rubble on a hillside overlooking the Kuskokwim River near Sleetmute.

Major mineral development came with the mercury shortages of World War II. Because of mercury's use in batteries, control instruments, munitions, and detonators, the U.S. War Production Board declared the liquid metal 'strategic' and initiated a policy conducive to domestic development. As a result, the Red Devil and DeCourcy Mountain mines produced several thousand flasks before the end of the war, but operations at Red Devil ceased as prices sharply dropped after the war. The DeCourcy Mountain Mine continued operation until 1949.

The price of mercury began to rise in late 1950, and in 1954, Alaska Mines and Minerals, Inc., decided to reopen the Red Devil Mine. Full-scale production was achieved by 1955, and by 1956 an all-time high of 5,100 flasks of mercury were recovered from three Alaskan deposits (but mainly from Red Devil). For the next 8 or 9 years, regularly scheduled F-27 flights from Anchorage and weekly barges from Bethel serviced the 65-80 employees of the Red Devil operations. The deposits were

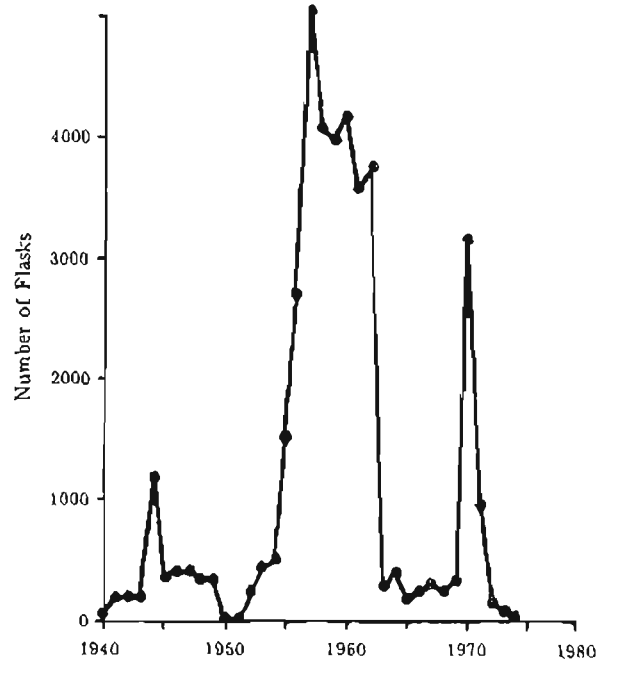

Fig. 2. Alaskan mercury production, 1923-74 (in 76-lb flasks). Total: 40,882 flasks.

mined from five levels aggregating 14,000 feet of underground workings.

The mine was notably wet, and high-capacity pumps were required to keep it from flooding. Gordon Herreid, former mine geologist at Red Devil, relates that there were some exciting times when the electric pumps failed. "It was like New York City during a power outage---an ominous silence from the power house and full knowledge the mine was beginning to flood." The wet conditions turned the mine muck into mud in both the drifts and stopes. This caused, in Herreid's wry words, "visiting geologists or engineers who usually wanted to see everything opting for a shortened tour."

By 1963, high-grade ore shoots were largely exhausted. Coincidentally, the price of mercury bottomed out, so the Red Devil Mine was shut down and allowed to flood. Total Red Devil output through 1963 amounted to 31,145 flasks won from 75,339 tons of ore (Beckwith, 1965).

In the late 1960's, the price of both mercury and antimony metal rose, partly because of the Vietnam war, and several cinnabar lodes resumed production. Antimony had previously been considered a deleterious and unwanted im-

purity at Red Devil because it clogged the retort furnace. But because of the high prices of both metals, the mine was reopened. Both mercury and antimony were concentrated by flotation, and sulfide concentrates were shipped to Japan. By late 1971, however, the bottom fell out of the market and the Red Devil Mine was shut down again.

The last producing mercury mine in Alaska was the White Mountain deposit south of McGrath. An Eskimo prospector from Sleetmute, Jack Egraty, discovered and staked the property in 1958; he later optioned it to Cordero Mining. White Mountain Mines managed to produce ore every year from 1963 to 1974, but production ceased when mine owner R.F. Lyman was killed at the mine site in a tractor accident.

Environmental considerations

Mercury vapor and certain mercury compounds---particularly the organic ones---are toxic. Although common mercury sulfides such as cinnabar are relatively stable, any person using mercury or in contact with mercury compounds should be aware of the potential hazard.

Cinnabar will sublimate (vaporize from a solid state) at the relatively low temperature of 580°C. This property makes the refining of mercury ores fairly easy. Heating cinnabar in a long section of iron pipe will sublimate the ore directly to mercury vapor. The vapor will condense to the liquid form, which can then be recovered. However, there have been several cases of mercury poisoning during the retorting of Alaskan ores. The toxic threshold limit of damage from mercury vapor is 0.1 milligram per cubic liter of air.

Because of cumulative toxicity, mercury's use in many pesticides, fungicides, and other industrial products have been prohibited. Despite the undesirable effects of mercury pollution, its safe use in batteries, lab apparatus, and control instruments makes substitution impractical; your home thermostat, for example, probably has a mercury switch. U.S. consumers still import over three-fifths of their requirements.

The future

The mercury-mining industry was built on a few individuals and small companies who realized that small high-grade deposits could be exploited during times of high prices and demand. Mercury is an ideal small-scale metal commodity for the miner in the Alaskan bush because retorted mercury or concentrates can be shipped by air.

Reserves of mercury in Alaskan and worldwide deposits are difficult to block out without expensive exploration and development. Many mines worldwide operate on less than 1 year of reserves. Speculative reserves of placer and lode cinnabar are known at several Alaskan deposits. According to Bailey and others (1973), Alaska may contain up to 20 percent of the nation's mercury resources.

Prices during the 1970's slumped primarily because the federal government sold 25,000 flasks of mercury on the market; it remained low because of subsequent environmental restrictions placed on this toxic substance. However, mercury-based medicines continue to be popular in the Orient, and every year Korean and Japanese buyers come through the DGGS offices inquiring about Alaskan mercury production. The current $400/flask price could spur more small-scale mining activities.

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New claims soar to all-time high

The number of new mining claims processed during the past 3-month period reached an all-time high, according to Mildred Brown, head of the DGGS mining-information offices.

The number of mining claims received for the October-December 1981 quarter was 10,209. This is the first time the active-claim tally topped the 10,000 plateau. The previous high, according to Brown's records, was the 9,668 claims processed in the last quarter of 1978.

By comparison, the total for this time last year was 7,877; there were 8,484 claims received during the fall 1981 quarter.

The claims received by recording districts follow:

Recording office	Oct.	Nov.	Dec.
Fairbanks	1,060	755	332
Barrow	1,493	322	2
Manley H. Spr.	26	20	40
Nulato	7	12	3
Mt. McKinley	34	111	188
Nenana	74	16	205
Rampart	10	6	0
Ft. Gibbon	672	36	0
Kotzebue	2,214	32	0
Talkeetna	99	315	62
Palmer	6	6	3
Nome	123	381	0
Seward	60	45	16
Juneau	191	21	47
Haines	0	1	5
Wrangell	10	0	0
Ketchikan	8	156	0
Sitka	2	3	6
Anchorage	5	573	69
Iliamna	89	0	0
Seldovia	0	35	0
Cordova	3	2	5
Chitina	60	0	0
Bethel	2	0	0
Kuskokwim	20	30	17
Homer	0	54	0
Kenai	9	0	0
Totals	6,277	2,932	1,000

Fourth Alaskan Placer Conference set for March 30, 31

The fourth annual Conference on Alaskan Placer Mining will be held March 30 and 31, according to spokesman Ernest N. Wolff, director of the UA Mineral Industry Research Laboratory, cosponsor of the meeting.

The 2-day meeting will again be held at the Fine Arts Concert Hall on the Fairbanks campus of the University of Alaska. The Alaska Miners Association is the other sponsor.

Papers will be presented on a number of topics, among them recovery of fine gold, economics and financing of operations, placer deposits of the Yukon, reclamation, smelting, remote sensing in exploration, and case studies of mines.

There will be a trade fair of mining equipment, with exhibits both indoors and outside the Fine Arts Complex.

Early registration is recommended, said Wolff. The fee is $25. A special-events fee of $35 includes two luncheons and a banquet, which will be held the evening of the 30th.

For further information on the program, contact Wolff at MIRL, University of Alaska, Fairbanks 99701 (ph. 474-7135). To register for exhibit space, contact the Conferences and Institute office, 117 Eielson Bldg, UA, Fairbanks 99701 (ph. 474-7800).

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DOT publishes transportation study on western Alaska mineral sites

In a report prepared by consultants for the Alaska Department of Transportation, the transportation-system requirements for the development of resources in three areas of western and arctic Alaska were analyzed.

Studied were the Noatak district, located about 60 miles from the Chukchi coast; the Ambler district, situated inland, about 250 miles from the Chukchi Sea; and Lost River, located on the south coast of the Seward Peninsula.

The areas were studied with respect to their mineral potential and to the transportation infrastructure necessary to permit both the export of

mineral concentrates and import of supplies (mainly fuel).

Transportation systems studied include road, rail, slurry pipeline, and tug and barge. In brief, the study states, "a slurry pipeline designed for arctic and permafrost conditions appears to be the most cost-effective alternative for the Noatak district. A railroad appears to offer the least-cost solution for the Ambler district, although it is not financially feasible at the present time. The development of the Lost River Mine does not appear feasible at this time."

The 57-page document, entitled, 'Summary report, western and arctic Alaska transportation study,' was written by Berger and Associates, with Philleo Engineering and Architectural Service. Details on the study may be obtained from John Martin, Alaska DOT Division of Planning, 600 University Avenue, Suite 1, Fairbanks, AK 99701. (ph. 907-479-4284)

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North Slope bibliography, five open-file reports highlight DGGS publications effort

DGGS published five open-file reports and a bibliography during the winter quarter.

The bibliography, entitled, 'Geological literature on the North Slope of Alaska, 1974-80,' was compiled by Karen S. Emmel, author of a recent DGGS bibliography on the lower Cook Inlet.

This 127-page collection includes references to most geological literature published between July 1974 and December 1980 on that part of Alaska north of 68°.

According to Emmel, "Most reports on offshore areas are included, and there are also some entries on adjacent areas in Canada." She said special emphasis was placed on petroleum geology during the literature search. The bibliography, which may be inspected at any DGGS information office (p.1), sells for $5.

Also published during the quarter were five open-file reports that range in geological location from the Brooks Range to the Aleutian arc and include bedrock geology, geothermal evaluation, and coal research. They are:

.AOF-140, 'Surficial geology of the lower Pilgrim River valley and vicinity, western Seward Peninsula, Alaska,' by J.T. Kline (2 pl., scale 1:63,360). $3.

.AOF-142, 'Coal investigation of the Susitna lowland, Alaska,' by R.D. Merritt, G.R. Eakins, and J.G. Clough (89 p. text, 4 pl., scale 1:250,000). $16.

.AOF-143, 'Physical rock-property values for selected rock types, southwestern corner, Wiseman Quadrangle,' by S.W. Hackett and J.T. Dillon (pl., scale 1:63,360). $1.

.AOF-144, 'Assessment of thermal-springs sites, Aleutian arc, Atka Island to Becharof Lake--Preliminary results and evaluation,' by R.J. Motyka, M.A. Moorman, and S.A. Liss (173 p. text). $7.

.AOF-146, 'Bedrock geology of the Fairbanks mining district, southeast sector,' by M.S. Robinson (pl., scale 1:24,000). $1.

In a related note, DGGS mining engineer Cleland Conwell and chief mining geologist Gilbert Eakins collaborated on an article synopsizing Alaska's burgeoning mining industry during 1981. The January issue of 'Alaska Construction and Oil' contains their 4-page feature 'Mining sees steady increase.' Free reprints may be obtained from any DGGS mining office.

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Alaska's role in national strategic-minerals picture relayed by DGGS geologist

DGGS geologist Tom Bundtzen reported on Alaska's strategic minerals in a conference held in early January in Washington, D.C. Bundtzen was one of six guest speakers at the annual meeting of the American Association for the Advancement of Science symposium entitled 'International minerals---A national perspective.'

The main topic of the talks was whether the U.S. could find a healthy balance between its need for strategic minerals and independence from unstable foreign sources.

Calling the present situation a 'pending crisis,' geologists presented papers examining U.S. policy as well as the policies of friendly trading countries such as Canada. The geological experts also reviewed U.S. dependence on South Africa, Russia, and Afghanistan, where rich deposits of strategic

minerals seem to have fallen within Soviet control.

Bundtzen told the symposium of Alaska's past contribution to U.S. needs for strategic minerals such as tungsten, platinum, and chromium during World War II and other conflicts. He reviewed the geology of strategic minerals in the 49th State and the ups and downs in mineral exploration and development as U.S. mineral policy has fluctuated.

The symposium was organized by Dr. A.G. Unklesbay, Executive Director of the American Geological Institute, and Dr. Allen F. Agnew, formerly with the Library of Congress. Other participants described aspects of the strategic-minerals issue.

In summarizing the symposium, Dr. Unklesbay said, "Geologists are global scientists, and their view of the Earth from the United States gives us a perspective that tells us the resources of the planet should be available to any nation in a free trade environment. Our national survival depends on it. We must work toward America's independence from foreign-controlled sources of the minerals we require to maintain our national strength. We must keep the pending crisis from becoming a reality."

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BLM publishes map of mining locations

(from Fairbanks Daily News-Miner, Jan. 21, 1982)

The Bureau of Land Management has published a new map outlining those areas in Alaska which are now open to mining.

Available for $2 at BLM offices in Fairbanks and Anchorage, the maps show federal lands which are not set aside in conservation units or for state or Native selection. Additional lands will be opened up to mining as they are cleared of claims by the BLM.

The map was prepared following discussions between U.S. Sen. Frank Murkowski (R-Alaska) and BLM State Director Curt McVee. Murkowski had been contacted by many miners who were unable to learn which areas of the state are now open.

[The BLM has offices at 707 C St. in Anchorage (zip 99501) and at Fort Wainwright in Fairbanks (PO Box 1150, zip 99707).--Ed. note.]

DGGS, USGS combine in peat study of Susitna Valley

Two areas in the Susitna Valley, about 60 miles northwest of Anchorage, contain an estimated 5.6 million tons of air-dried peat, according to two peat-resource maps prepared by the U.S. Geological Survey in cooperation with the state of Alaska.

USGS geologist Cornelia Cameron said that the deposits meet the criteria for fuel-grade peat, and their energy value is at least 8,000 Btu/lb of dry peat.

The study, funded by the U.S. Department of Energy through the Alaska Division of Energy and Power Development and DGGS, provides background on the energy and economic resource potential of the areas, which are state, borough and private lands.

In early February, the state selected two firms, Wheelabrator-Frye of Hampton, N.J., and Northern Technical Services of Anchorage, to study the feasiblity of mining, processing, and marketing Alaska's south-central peat resources as an energy commodity.

Each of the reports consists of several map sheets that show surficial geology, areas of peat resources, the results of shallow coring, cross sections, and tabular data.

The three-sheet study of the Rogers Creek area in the Susitna Valley shows an estimate of 3,857,000 tons of air-dried, fuel-grade peat in surface deposits that average 6-9 feet thick.

The two-sheet study of the Houston area of the Susitna Valley shows an estimate of 1,785,000 tons of air-dried, fuel-grade peat in surface deposits that average 5 feet thick.

Stuart Rawlinson and Steven Hardy of DGGS were coauthors of the maps with Cameron and Thomas Malterer, then of the Minnesota Department of Natural Resources.

The maps may be purchased from the USGS, Box 25425, Federal Center, Denver, Colo. 80225. They may be inspected at numerous USGS offices and at the DGGS College office.

.'Surficial geology and peat resources map of the Houston area, Susitna Valley, Alaska,' USGS Open-File Report 81-1301 ($8.25; $1.00 for microfiche).

'Surficial geology and peat resources map of the Rogers Creek area, Susitna Valley, Alaska,' USGS Open-File Report 81-1302 ($9.75; $1.50 for microfiche copy).

Additional peat maps

In addition, DGGS and Northern Technical Services are preparing a report and maps of peat resources in other parts of the Susitna Valley and near Dillingham. DGGS is also producing a map of statewide peat resources. Both products will be available in April 1982.

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He's a Rhodes Scholar from the North Slope

(from Fairbanks Daily News-Miner, Dec. 21, 1981)

Mark Helmericks, a 1976 Lathrop High School graduate who didn't see the inside of a schoolroom until the ninth grade, has been selected for the prestigious Rhodes Scholarship.

Helmericks, son of Bud and Martha Helmericks of Colville Village, got his first 8 years of education from state correspondence courses given by his mother at their home in the Colville Delta on the North Slope, 50 miles west of Prudhoe Bay.

He is to graduate from Harvard University with a degree in economic geology in June. The 23-year-old Alaskan is a varsity oarsman at Harvard, a licensed assistant guide in Alaska, and a private pilot with land and floatplane ratings.

Helmericks is one of 32 Americans named Rhodes Scholars, who receive full tuition and support for 2 years of study at Oxford University in England. The coveted scholarships were established in the will of British colonial pioneer Cecil Rhodes, who died in 1902.

"I plan to work in the geochemistry department at Oxford and broaden the base I've developed at Harvard before applying at graduate schools for a Ph.D program in geochemistry and economic geology," Helmericks said in describing his plans. "I hope to graduate with honors at Harvard in June, and the Oxford program starts in the fall."

He grew up in a home his father ---a well-known bush pilot, guide and lecturer---built on the Colville Delta in 1958. Mark first entered public school in the ninth grade at Fairbanks Ryan Junior High School in 1973, and earned straight A's during his first year in a classroom. The experience has made him a firm believer in the correspondence course program.

"You can most definitely get a good education that way," Helmericks said. "The key is having dedicated parents to put in time to adequately train you."

When he graduated from Lathrop, Helmericks was offered an athletic scholarship to the University of Alaska, but he chose to go to Harvard. He worked for 2 years on the Union Oil Co. oil well on an artificial ice island in Harrison Bay to earn Harvard's $12,000 to $15,000 annual tuition.

Helmericks started in Harvard in the fall of 1978 with no major course of study mapped out. He then started in economics, but rapidly switched to the sciences, setting on geology with an emphasis on chemistry.

Harvard calculates academic ratings by groups, from one to six with one being the highest. Helmericks' grade average his first 2 years were roughly B minus, but he is now high in the group that equates to B plus. He believes he might edge into Group I this year.

"In the East, there's much emphasis on college preparatory classes, which we don't have in the public school system out here," he said. "I wasn't all that well prepared academically and I had to really scratch my first and second year."

Helmericks was invited to try out for the Harvard rowing team, and made the team his freshman year. But at 6 feet 2 inches and 190 pounds, he said he's a bit small for the crew and has to row near the front of the hull. Knee surgery caused him to miss the season his junior year.

Among other achievements, he became an assistant guide at age 18, got a student pilot's license at age 12, and private pilot's license at 19. Helmericks hopes to earn a registered guide license, and he is working on his commercial and instrument ratings.

Last summer he worked for a mining company in Peru and northern Bolivia doing research for his senior honors thesis.

DGGS expands hydrology staff

DGGS continues to grow. This quarter there are three new hydrologists and a geologist in the Eagle River facility, a programmer in Anchorage, and several new clerks.

Newcomer George A. McCoy is the hydrologist in charge of the Water Quality Program. A 9-year veteran of the USGS Water Resources Division in Anchorage, McCoy has a Ph.D. from Oregon State, an M.S. from Central Michigan, and a B.S. from Ohio State University. His field of study is aquatic plants and algae. A bachelor, George likes downhill skiing and is a musician; he plays the Slovenian Button Box, an accordian, for his own group, the Loose Moose Polka Band.

Stanley J. Carrick is a new hydrologist in the Navigability Program. Carrick has a B.S. in geology from the University of Montana and an M.S. (1981) from Western Washington University. Stan is married and likes cross-country skiing and running.

Another new hydrologist in the Navagability Program is Roger A. Clay, who came to DGGS from the U.S. Forest Service in Petersburg. The 28-year-old hydrologist has a B.S. degree from the University of Wisconsin in waterresource management. Roger is single and likes fishing and skiing.

Another new face is not really that new. Kerwin J. Krause, surficial geologist in the division's Hazards Program, is a former DGGS field assistant (summer of '73). He will be mapping in the Kuskokwim River, Anchorage Quadrangle, and Skagway areas this coming field season. Krause, now 31, has degrees in geology from Alaska Methodist University (B.A.) and the Mackay School of Mines, Reno, Nevada (M.S.) Kerwin and his wife, Alma, an Anchorage music teacher, like outdoor sports.

In Anchorage, DGGS has a new systems analyst in the person of Bonnie H. Polmer. Our resident 'southern belle,' Polmer has a B.S. in math from LSU and an M.S. in statistics from Tulane. Bonnie has been in Alaska nearly 2 years, and says she likes skiing on 'that funny white stuff.' She is unmarried.

DGGS has three new clerk-typists. All three are married and have no children. Two, Mary A. Maurer and Jean M. Bird, are 2-year Alaskans. (Mary works in the Anchorage office and Jean in College.) The third, Bernice A. Syvertson, is working primarily on College office personnel matters. Bernie came to DGGS from the administrative staff of the University of Alaska, where she worked for 9 years.

Also in College is new mining information clerk Sandra V. Garbowski. Sandy came to DGGS from the Federal Aviation Administration in Fairbanks, where she had worked for the past 3 years. She, too, is married with no children.

Gone are Ruth H. Decker, a clerk in the Fairbanks office who transferred to another department, and 12-year Survey veteran Nola J. Bragg, who resigned January 21. Bragg started with the Survey in 1970 in College as a clerk-typist and gradually advanced to become the division's administrative assistant in Anchorage. Nola now lives in Eagle River with her husband and children.

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U.S. Borax begins Quartz Hill project

(from All-Alaska Weekly, Jan. 22, 1982)

Dr. Carl Randolph, President, announced that U.S. Borax has signed a letter of intent with Bechtel Civil & Minerals, Inc. of San Francisco for the engineering and construction of the company's Quartz Hill molybdenum project, located in southeastern Alaska.

Bechtel will begin work immediately on completion of design of the initial access road from tidewater to Quartz Hill. Construction of the 10-mile road is scheduled to begin in early 1982, pending approval of the necessary permits.

During 1982-83, Bechtel will prepare the preliminary design and cost estimates for the future plant and mine. This will be followed by plant construction in 1984, with full mine production to begin in 1987.

U.S. Borax discovered the Quartz Hill mineral deposit in 1974. Today, the molybdenum deposit is one of the largest known in the world. U.S. Borax has over the past 7 years drilled more than 230,000 feet of core, which indicates a deposit in excess of 1.5 billion tones of minable ore.

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"Volcanoes throw out saliva."---Geological Howlers.

'Dolly Llama' returns to Arctic

Well, now it can be told---namely, the heart-rending tale of how John Dillon, bearded DGGS geologist and chief of the Brooks Range field party, fell in love last summer with a llama.

Now, John didn't trip head over heels for just your normal everyday run-of-the-mill llama, mind you. He has taste. He chose the prettiest one of the six he had shipped to the Brooks Range for his field party.

Here's how it all happened. Mitch Henning, Anchorage-based DGGS geologist, is raising three young llamas (Teku, Kula, and Nicole). His friend, Jim Faiks, has three fully grown ones (Frodo, Bilbo, and Darwin). They donated the use of their six animals to DGGS to test their ability to live and work on an 11-day geological traverse in the Arctic.

Last August, Mitch and Jim drove the llamas from Anchorage to Dietrich Camp, 370 miles above Fairbanks on the Dalton Highway. There they met Dillon and three other DGGS geologists to begin their experimental trek through the Arctic wilderness.

Llama history

Llamas aren't natives of North America and haven't been used as beasts of burden in the Brooks Range in modern times---if ever---but llama history and geologic history are linked there.

Llamas have been used as beasts of burden in South America for thousands of years. Adults weigh up to 400 lb and can carry one-fourth of their body weight all day long. They have a two-toed foot with a soft pad similar to a goat's foot and can readily negotiate rough terrain.

Llamas are people-oriented domestic animals. They can hike several days without water, are ruminants and eat most vegetable matter, and are very docile. Henning says llamas are curious and alert hiking companions and are considered excellent pack animals.

Llama evolution and geologic history are linked in the Brooks Range. During the Great Ice Age, 10,000 to 1,000,000 years ago (the Pleistocene Epoch), the formation of massive glaciers resulted in a lower sea level, which exposed the Bering Sea land bridge and allowed the linking of present-day Siberia and Alaska. Among the European and Asiatic mammals to cross the bridge into the area we now call the Brooks Range were the precursors of today's llamas. These early animals (camelids) eventually migrated to the Andes, where they evolved into the llama, alpaca, guanaco, and vicuna.

So, a million or so years later, Frodo and his friends are retracing part of the great migration of their ancestors. They are on an epic journey.

General Garcia in the Andes? No, it's simply Frodo and Darwin flanking DGGS geological assistant Dave 'Grizz' Adams in the Brooks Range.

The trek

The plan called for leaving the Dalton Highway at Dietrich and 'hoofing it' 80 miles in all, first to the east over the mountains separating the Dietrich River from the next major north-south valley, the Matthews River, continuing north along the Matthews River for 5 miles and then crossing a second major ridge to the Big Spruce Creek drainage. From there the party was to go to the headwaters of Big Spruce Creek, recross into the Matthews River, hike north to its origin, and finally return to the Dalton Highway, about 15 miles north of the starting point. The field party would traverse numerous ridges and valleys along the route, mapping about seven townships before ending the trek.

DGGS mascots

What are those furry beasts doing in Alaska, you ask?

Well, Henning bought two males from a breeder in Oregon a couple of years ago. They are a gregarious animal and will not survive long alone; hence Mitch's purchase of the pair. Males cost $500 each. Last year, he plunked down $3,500 and brought home Nicole, a doe. All three are young---about a year and a half old---and cannot breed yet for another year or so.

Mitch's wife, Chris, loves them for a reason other than their sunny dispositions---their wool. Llama wool is a very light and a very warm material, much like qiviut (muskox wool). Chris spins the wool into yarn on her loom and then knits it into sweaters, afghans, hats, and so forth. (Mitch has the warmest 'so forths' in the state.)

The test

The llamas began their trek in the Brooks Range carrying a total of 520 lb. (Faiks' three averaged 100 lb each; Hennings' 'teenagers' each carried about 60 lb.) Eleven days later, they packed out half that---265 lb.

Where did the rest go? we asked John. "Well, some went in our stomachs, some in theirs, and some on our backs," he said.

How did the llamas perform?

"They weren't malingerers," he continued. "They did a good job, traversing loose, fine scree, making ascents and descents of 1000 feet per mile, bashing through alder scrub, slogging through muskeg, and fjording rivers. Bears didn't bother them," Dillon said, "although they were curious about the Dall sheep they saw along the way."

Dillon did concede that people made the best pack animals, however, when it came to hand-over-hand climbing and traversing blocky talus. "We helped them along by carrying some of the stuff in these situations." He added, "we would have had to pack it ourselves any other time. Either that or have it flown in by helicopter, which is pretty expensive."

Aside from their getting tired, I ask, did you have any problems with them?

"Only on the last day. About 3 miles from the Dalton Highway, Darwin's right front foot started to bleed from an inch-long cut in his pad. The pad had a fungal infection long before the trip and it was no surprise that the sharp blocks in the creek bed cut it." Dillon continued, "We applied hydrogen peroxide and a leather sandal we had made for just such an emergency. The leather covered Darwin's pad and was laced up his leg." Did it work?

"Oh yes," John said. "It protected his foot and stopped the bleeding, although a veterinarian in Anchorage 3 days later told us we had 'one exhausted llama' and prescribed 2 weeks of rest and tender, loving care."

You managed to keep to your schedule, then?

"Yes, we made it back to the highway on the eleventh day. On that day, we had a ball waving to the truckers passing by, and speculated on the sight we must have presented to them." Dillon grinned, "I'm sure some of the truckers' CB buddies further on down the line thought they had been nipping on the old tundra juice once they told them what they had just seen."

"Head 'em up, move 'em out." Llama owner Mitch Henning leads one of his three youngsters across a stream in the Brooks Range.

Judgment day

What is your final evaluation of the llamas, John? Would you use them again?

"Hey, man, pass the word. Llamas are right at home in the Brooks Range. They carried our gear into the steep backcountry and out again without incident. No horse or mule could have done

it. They couldn't have negotiated the route or subsisted on the meager browse." Dillon is really cooking now. He's wired, relishing memories of last summer.

He continued. "We covered our desired territory and mapped what we had planned to do. In addition, we had a unique wilderness experience and learned valuable lessons about the terrain llamas will cross."

John summed it up, "Those little critters are all right."

Sure, John, sure. But does Mary REALLY know how you spend your summers?

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Unalaska geothermal energy: Taming volcanoes for profit

(from Alaska Industry, January 1982)

The eruption of Mt. St. Helens awoke the world May 18, 1980, and kept Washington state officials and geologists nationwide scrambling for months. Now the state of Alaska is embarking on an ambitious program to tame some of the awesome energy trapped beneath the surface of the volcano's distant, northern cousin, the Makushin Volcano on Unalaska Island.

One of 88 active volcanoes in the Aleutian Chain, Makushin is the focus of a multimillion-dollar geothermal power study funded by the state Legislature. The Alaska Power Authority has awarded a $4.7-million contract for preliminary geothermal development on the island to Republic Geothermal, an engineering and energy firm based in Santa Fe, Calif., and currently is negotiating the details.

The state agency expects to have the contract signed some time this month, with the first phase of the project beginning "immediately" afterward, said Patty DeJung, project manager for the Alaska Power Authority.

Republic Geothermal and its subcontractors--Dames and Moore Consulting Engineers of Anchorage--will prepare a detailed exploratory drilling plan, sink three shallow test holes, and then drill a deep hole to tap the geothermal energy, she said.

What will happen after the deep hole is drilled is almost entirely a matter of conjecture. Political concerns must be addressed: should the project be turned over to the private sector or should the state continue the development? The answer to that question may come from the Aleut Corp., a Native Corporation that has selected the region encompassing Makushin Volcano as part of its entitlement under the Alaska Native Claims Settlement Act, although the lands have not yet been conveyed.

"We're expecting (the geothermal well) to be hot enough for electrical generation," DeJung said, "It could be similar to the Geysers in California."

A geothermal development in Northern California, the Geysers, is one of the three largest such projects in existence, annually providing electricity to thousands of homes and businesses in Sonoma County. The other mammoth geothermal power projects are located in Wairakei, New Zealand, and the Larderello area of Italy. The Larderello project, the eldest, has been in operation in one form or another since 1904 and currently has an installed capacity of 360 megawatts (MW).

Unalaska Island has tremendous potential for geothermal power development, according to Dr. Michael J. Economides, a consultant working on the Makushin Volcano project under contract with the Alaska Power Authority.

Economides said geothermal energy is "location intensive. You cannot transport geothermal (power)," he said. "You must have the market to utilize it on top of the geothermal source.

"Unalaska has the resource. It also has the market--the population and the fishing industry. That's why Unalaska is such an attractive prospect--because it has both," he said.

Hydrothermal systems

There are three primary types of geothermal resources: hydrothermal, hot dry rock, and geopressured zones. Nearly all of the currently developed geothermal resources are hydrothermal systems, where naturally occurring ground water is heated at depth. These systems can be either vapor-dominated (steam) or hot-water dominant, depending on temperature and pressure.

The essential ingredients for a hydrothermal system are a heat source, a sufficient supply of ground water, and a mechanism for transporting the heated ground water to near the surface (porous rock or natural fractures).

The other two types of geothermal resources are hot dry rock, which requires injecting water as a heat-transfer medium, and geopressured zones, where water is trapped with natural gas under thousands of feet of sediment.

Among other things, Republic Geothermal's exploratory work on Unalaska Island will determine the temperature of the water trapped in Makushin's "roots," and how far below the surface the potential source of energy lies.

The test holes the firm plans to drill will be about 1,500 feet deep, while the development well or deep hole could be drilled between 4,000 feet and 6,000 feet into the earth, DeJung said.

The depth of the final hole is only an estimation, she said, because "you don't know until you go in how deep it will have to be."

Unalaska's energy needs

Included in the nation's purchase of Alaska in 1867, Unalaska Island was all but ignored by its "mainland" neighbors until 1900, when the island's port of Dutch Harbor became a transshipping point for Nome after the discovery of gold turned Nome into a boom town. Dutch Harbor next entered the history books during World War II. In 1940, the U.S. Navy established a base in the harbor, which was bombed two years later by the Japanese. The U.S. launched a successful counterattack in 1943.

Nearly four decades later, the port of Dutch Harbor has grown to achieve another kind of importance. Since 1979, the port has been the nation's leading fish harbor, and about 200 million pounds of crab and fish are processed at Dutch Harbor annually.

The same geographical factors that made it important during the war have made the harbor a vital shipping center for traffic between the western Alaska mainland, the Aleutians, and the oil-rich North Slope.

According to the U.S. census, 342 people lived on Unalaska Island in 1970. A decade later, the population count has increased nearly fourfold to 1,322; and during the peak fishing season, the population swells to over 5,000.

Outer-continental-shelf oil and gas exploration in the Aleutians, increased bottom fishing in the Bering Sea, and the possible expansion of its role as a transshipment point (it is the only place between Kodiak and Yokohama that a container ship can dock) all indicate Unalaska will continue to grow in importance and population.

The installed electrical capacity on Unalaska Island currently is under 12 megawatts. The U.S. Bureau of Land Management projects the island's power demands will increase by 40 MW by the year 2000. Because of the projected demand--and the high cost of the diesel fuel Unalaskans now depend upon for all their power--the state is investing time and money for an in-depth look at the island's 241,000-acre Makushin Potential Geothermal Resource area.

Economides estimated that a 30-MW geothermal power plant could be built on Unalaska Island for about $42.35 million (in 1981 dollars). Although the investment costs are high, a 30-KW geothermal power plant would be cheaper to build and operate than a hydroelectric or diesel power plant of comparable size, he said.

The state is also investigating other potential geothermal energy developments. A partial list, supplied by Donald Markle, energy projects manager for the Division of Energy and Power development, includes Pilgrim Hot Springs near Nome, the Copper River Basin, particularly the Glennallen-Copper Center area near the Glenn and Richardson highways; Adak Island, near the center of the Aleutian Chain; Akutan Island, located approximately 770 miles southwest of Anchorage in the Fox Island group of the Aleutians; and Tenakee Springs, situated between Sitka and Juneau.

"Alaska has a lot of geothermal energy. To my way of thinking, it has as much as the rest of the U.S. combined," Economides said. "But it lacks the population to use it."

(On a related note, DGGS has released two new open-file reports on geothermal energy. One, AOF-140, is a two-plate geologic map of the Pilgrim Springs area of the Seward Peninsula. The other, AOF-144, is a lengthy (173-page) assessment of 20 thermal-springs sites from the Aleutian arc to Becharof Lake, on the Alaska Peninsula. See p. 6.--Ed. note.)

Sohio experiments in Beaufort Sea

(from Alaska Construction & Oil, December 1981)

Two large steel tripods called arctic dolphins are being tested off Alaska's Beaufort shore as a possible replacement for reinforced gravel islands that are now used for offshore oil activities. If the relatively inexpensive dolphins can create a solid ice barrier, "We'll be looking at a considerable cost savings" over gravel islands, said Bob Potter Sr., Sohio's offshore engineer.

The company will also be able to consider placing drilling platforms, barges and other exploration support equipment offshore with the assurance it will be safe from moving ice. The arctic dolphins were transported by a barge to the study site in September before freeze up.

The site is about 8 miles offshore, 3/4 mile northwest of Reindeer Island, a natural barrier island in the Beaufort. They measure 40 feet square and stand 30 feet high.

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Columbia Glacier retreats at unprecedented rate

(from the Associated Press, Seattle, Jan. 1, 1982)

An Alaskan glacier scientists say is out of step with geologic time will be dumping millions of tons of ice in the paths of oil tankers this summer, a glaciologist predicts.

The Columbia Glacier, terminating near the mouth of the oil port of Valdez, is in a rapid retreat never before witnessed by scientists, Mark Meier of the U.S. Geological Survey in Tacoma, Wash., said in an interview last week.

Since 1978, the 41-mile-long glacier has retreated 1.2 miles, leaving behind ever-increasing numbers of icebergs.

The rate of retreat is expected to rise to 2.5 miles per year by the mid-1980's, with up to 27 million tons of ice per day dropping into the waters of Prince William Sound.

By contrast, the 425-square mile glacier dropped less than 4 million tons of ice per day last summer, Meier said.

The danger to shipping from icebergs will decrease every year after the mid-1980's, he noted, as the terminus of the glacier gets farther away from Valdez.

The reason for the rapid retreat remains a mystery, Meier said. He discounts the theory that an increased release of carbon dioxide from the burning of fossil fuels is warming the atmosphere, creating a "greenhouse effect" that will melt the world's ice sheets and raise sea levels.

Meier said the Columbia Glacier simply seems to be a late bloomer, centuries out of step with other glaciers that retreated long ago.

The rapid retreat was noticed for the first time last summer, when the average yearly slide back of 150 feet suddenly jumped to 1,650 feet. The ice chunks dropped into the Sound caused some oil tankers to restrict their arrivals and departures to daylight hours.

In Valdez, Coast Guard Lt. Cmdr. Roger Holmes said the agency "hasn't got a set of guidelines on exactly what we're going to do."

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Our Gangue....

By Frank Larson, editor

All of us probably are, to some degree, superstitious. My contacts with Lady Fate are strictly seasonal ---in the dead of winter. Verily, on those deathly still, bitter mornings, when it seems that the mere crunching of snow beneath your feet will render major structural damage to your neighbor's house, one must gather up one's talismans and begin reciting litanies ---anything to help you start that car. You laugh? Obviously, you have never tried to disinter the family wheels from Mother Nature's frigid grip .... First off, you must, over the years, determine the idiosyncracies in the metabolism of Old Whatsisname, the hitherto-faithful courier. This done, you realize that it will respond only to a set wintertime routine---however bizarre---and that any deviation in the starting procedure will not only run down the battery and thereby render the old beater useless, but will cause it to inexorably slide into a silent, eerie coma until spring. So, to counteract this malevolent by-product of the Industrial Age, you inerringly find yourself, eyes pinched shut and breathless, praying for the engine to fire. In my car-starting method, some rather diverse and incongruous sources

of input aid me in my matutinal obeisance to Lady Fate---arcane incantations from Haiti, a wooden stake from the Carpathian Mountains, and a paean to motherhood (roughly) from the U.S. Deep South....But they work, and Old *%@#! (nickname censored), now in its second tour of the odometer, usually starts ....But here, courtesy of a local printer, is a recipe for starting the typical Alaskan car:

Cheechako: Owner, fresh from America, dashes out at 7:45 a.m., full of optimism and energy, and a) chops off enough ice from the windshield to form a peephole (theory being that a line from the steering wheel over the center of the radiator will guide one down the street), b) injects a pint of ether into the carburetor, c) pours a pint of alcohol into the tank (takes snort himself), and d) steps on the starter, which is connected to four truck batteries. Result: Arrives at work 3 hours late...Sourdough: a) Arises at 3:00 a.m.; b) digs car from ice and snow; c) kicks car soundly 3 or 4 times to establish respect for authority; d) appears disinterested in whether car starts, lights pipe from bonfire previously lighted to warm hands, and hovers in the vicinity, musing aloud about the beauty of the northern lights; e) raises head, shakes same disapprovingly, and mumbles several reasons aloud why the purchase of a new car is indicated; f) kicks car soundly 4 more times; g) returns to house with feigned intention of remaining; h) drinks a cup of coffee, making sure car can see him through the window; i) nonchalantly saunters back and kicks car 4 more times; j) pries open door with crowbar and chips icicles from dash, steering wheel, and seat; k) pulls choke out 3 feet; l) twists ignition key to 'on' position with vise-grips; and m) slams foot on starter while simultaneously kicking car again with free foot, cursing imaginatively, and beating dash with ballpeen hammer. Result: Arrives at work only 1 hour late....In petroleum news, 10 oil companies bid $62 million for half of the oil and gas rights offered in the latest Nat'l Petroleum Reserve-Alaska lease sale on Jan. 26. It was about 1/4 of what the feds hoped to get. One month later (late issue this time, folks), Interior Sec'y Watt threw out 4 of the bids.... The state's oil and gas lease-sale 34, scheduled for May 26, has been tentatively postponed until September because of a lack of seismic data available for evaluation, according to the DNR Division of Minerals and Energy Mgmt....On the minerals front, Anaconda Copper signed an exlusive agreement with the Cook Inlet Region, Inc., a Native association, to explore for minerals on 24 million acres in south-central Alaska. District geologist Dave Heatwole says his firm plans to invest millions in exploring for copper, lead, zinc, chromium, tin, nickel, and precious metals....Cominco America and the NANA Native Corporation have announced they have come to an agreement on the evaluation of the Red Dog deposit, in the western De Long Mts, 90 miles north of Kotzebue. After drilling 14,700 feet in 39 holes, Cominco announced an in-place holding (without mining dilution) of 85 million tons of 17.1% zinc, 5% lead, and 2 oz/ton silver. (In one exceptionally rich hole, these values were 28.7%, 8.5%, and 4.) Geologist Roy McMichael says the deposit is relatively flat lying and suitable for open-pit mining. (One DGGS geologist called the find "a real elephant.")....In DGGS news, all College personnel except the assay lab are now in the Nat'l Bank of North Bldg, at Geist Rd and University Ave; the mailing address is the same but the phone number was changed to 474-7062 ....DGGS and the USGS have signed a Memorandum of Agreement and AWRE--Alaska Water Resources Evaluation---is the result. The pact enables both agencies to save money and time by combining forces on specified areas of mutual concern around the state. Whenever possible, the DGGS Hydrology section, located in Eagle River, will share equipment and other areas of technical expertise (computer systems, for example) with the USGS Water Resources Division.... Lastly, we're going to update Information Circular 8, 'List of consultants available for work in Alaska.' If you want to be included in the 1982 version, send us a note with your firm name and address. Note your area of expertise (hardrock, petroleum, permafrost, geophysical, whatever), and when spring comes, the sun will warm up Old *%@#! and I'll take the updated version to a printer.....Cheers.

Metals Market

	January 25, 1982	3 Months Ago (10/30/81)	1 Year Ago (12/29/80)
Antimony metal per lb, NY dealer	$ 1.25	$ 1.26	$ 1.47
Barite (drilling-mud grade per ton)	$ 32-61	$ 95-115	$ 30-60
Beryllium ore, stu*	$100-130	$130.00	$ 90.00
Chrome ore per long ton (Transvaal)	$ 51-55	$ 55.00	$ 51.00
Copper per lb. (MW-prod.)	$ 0.769	$ 0.81	$ 0.868
Gold per oz.	$377.25	$427.14	$594.75
Lead per lb.	$ 0.30	$ 0.38	$ 0.39
Mercury per 76-lb flask	$392.00	$420.00	$360.00
Molybdenum conc. per lb. (Climax)	$ 7.90	$ 7.90	$ 9.20
Nickel per lb. (cathode)	$ 3.20	$ 3.45	$ 3.45
Platinum per oz.	$357.70	$415.30	$475.00
Silver, New York, per oz.	$ 7.89	$ 9.04	$ 16.15
Tin per lb., MW composite	$ 7.69	$ 7.90	$ 7.69
Titanium ore per ton (ilmenite)	$ 70-75	$ 70.00	$ 55.00
Tungsten per unit (GSA domestic)	$120.00	$125.21	$128.05
Zinc per lb. (MW-US PW)	$ 0.42	$ 0.46	$ 0.406

* - Standard ton unit (20 lb)

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