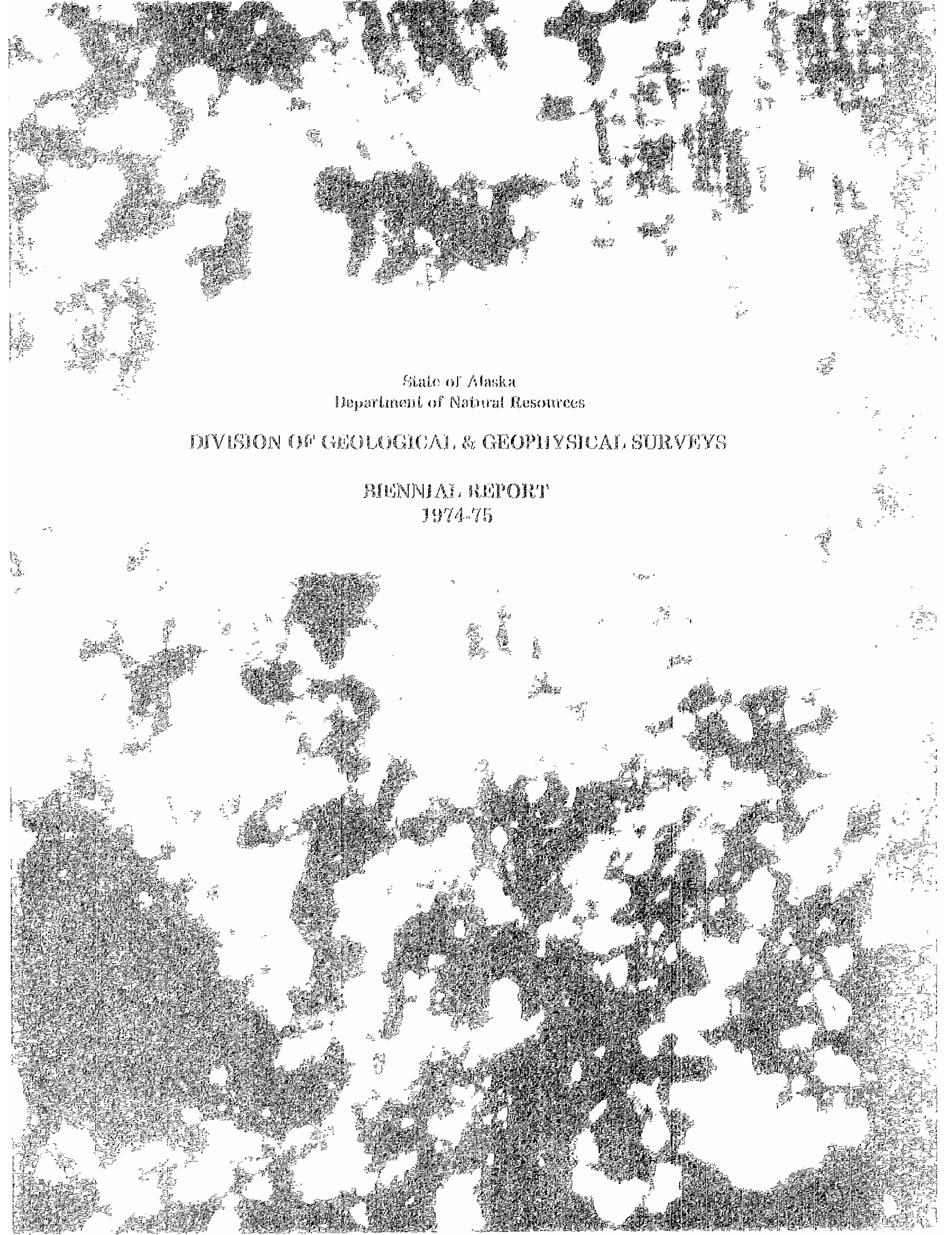

State of Alaska
Department of Natural Resources

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

BIENNIAL REPORT
1974-75

BIENNIAL REPORT 1974-75

STATE OF ALASKA—DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL AND GEOPHYSICAL SURVEYS

Jay S. Hammond, *Governor, State of Alaska*
Guy R. Martin, *Commissioner, Dept. Natural Resources*
Ross G. Schaff, *State Geologist*

P.O. Box 80007
College, Alaska 99701

3001 Porcupine Drive
Anchorage, Alaska 99501

Cover photo — Example of microcline granite from the Arrigetch pluton, Survey Pass quadrangle, Alaska, approximately 10 miles north of Walker Lake, Brooks Range, Alaska, by T. C. Mowatt (presently with the U. S. Bureau of Mines). Other photos by T. K. Bundtzen, S. W. Hackett, L. F. Larson, W. M. Lyle, D. L. McGee, K. M. O'Connor, G. H. Pessel, R. M. Tosdal and M. A. Wiltse.

STATE OF ALASKA

JAY S. HAMMOND, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

P. O. BOX 80007
COLLEGE 99701

February 13, 1976

The Honorable Guy R. Martin
Commissioner
Department of Natural Resources
Pouch M
Juneau, Alaska 99811

Dear Commissioner Martin:

I am pleased to submit this report of the Division of Geological and Geophysical Surveys' activities during 1974 and 1975.

These activities reflect the broadened capacities and responsibilities of the Division as it participates in the long-range planning for the wisest use of Alaska's vast energy and mineral resources.

As Alaska faces another year of critical decisions, we will continue to provide fundamental geologic data so that these decisions can be of the highest quality.

Respectfully submitted,

Ross G. Schaff

Ross G. Schaff, Ph. D.
State Geologist

JAY S. HAMMOND
Governor, State of Alaska

GUY R. MARTIN
Commissioner, Dept. of
Natural Resources

ROSS G. SCHAFF
State Geologist

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Plane table alongside Beluga River, south-central Alaska; Foreland Formation in background.

INTRODUCTION

PURPOSE

The Division of Geological and Geophysical Surveys, according to Alaska Statute 41, is charged with conducting "geological and geophysical surveys to determine the potential of Alaska lands for production of metals, minerals, and fuel; the location and supplies of ground waters and construction materials; the potential geologic hazards to buildings, roads, bridges, and other installations and structures; and shall conduct such other surveys and investigations as shall advance knowledge of the geology of Alaska."

STRUCTURE

DGGS has main offices in Anchorage and College (near Fairbanks). The Division was reorganized into several specific sections, all under the direction of the State Geologist: 1) resource investigations, 2) minerals analysis and research laboratory, 3) regulation and information, and 4) publications. Administrative functions are performed under the direction of the State Geologist, who maintains his office in Anchorage. The Division, which has about 35 full-time employees, also has four mining information offices (p. 25), where files of mining claims, deeds, and affidavits extending back to 1954 are maintained for public use. Figure 1 shows the functions of DGGS.

PERSONNEL

In November 1974, Jay S. Hammond was elected Governor, succeeding William A. Egan. The following March, Gov. Hammond appointed Dr. Guy R. Martin, an attorney specializing in natural-resource law, as Commissioner of Natural Resources. Martin in turn named Dr. Ross G. Schaff, Academic Dean at Alaska Methodist University, to the post of State Geologist, succeeding Donald C. Hartman, who had returned to private industry in late 1974.

In other personnel changes, Thomas K. Bundtzen and Drs. Milton A. Wiltse, Wyatt G. Gilbert, and Richard D. Reger joined the resource investigations unit; Steve W. Hackett became the Division geophysicist; Gordon Herreid retired; and Dr. Thomas E. Smith resigned. Jeffrey T. Kline and Joanne K. Welch joined DGGS as geologic assistants.

In the Minerals Analysis and Research Laboratory (p. 23), supervisors Dr. Thomas C. Mowatt and Thomas C. Trible resigned. Henry S. Potworowski was named lab supervisor in mid-1975. New lab personnel include Nicki D. Coursey, geochemical analyst, and Gail A. Martin and Gregory E. Douglas, lab assistants.

In the regulation and information section (p. 25), Mildred E. Brown (College) and Agnes M. Burge (Juneau) left their positions as mining information specialists and were replaced by Patricia G. Dieterich and Earleen L. Grose. Also, because of the large increase in mining claims filed, Carole H. Stevenson was promoted to mining information specialist.

In the publications section (p. 43), Ann Schell was hired as cartographer for the College office. Other new personnel were clerk-typists Carolyn J. Bonnet and Robbin L. Gilmore in Anchorage and Mona J. Robinson in College.

ADMINISTRATION

Bonnet, Carolyn J.	- Clerk-typist
Bragg, Nola J.	- Secretary
Gilmore, Robbin L.	- Clerk-typist
Schaff, Ross G.	- State Geologist

RESOURCE INVESTIGATIONS

Bewley, Georgia A.	- Geological assistant[1]
Bundtzen, Thomas K.	- Mining geologist I
Buza, John W.	- Geological assistant[1]
Carver, Cheri L.	- Geological assistant[1]
Dobey, Patrick L.	- Chief petroleum geologist
Eakins, Gilbert R.	- Chief Mining Geologist
Gilbert, Wyatt G.	- Mining geologist III
Hackett, Steve W.	- Exploration geophysicist
Henning, Mitchell W.	- Mining geologist I
Klein, Robert M.	- Stratigrapher
Kline, Jeffrey T.	- Geologic assistant
Lyle, William M.	- Petroleum geologist
McGee, Don L.	- Petroleum geologist

[1] Seasonal

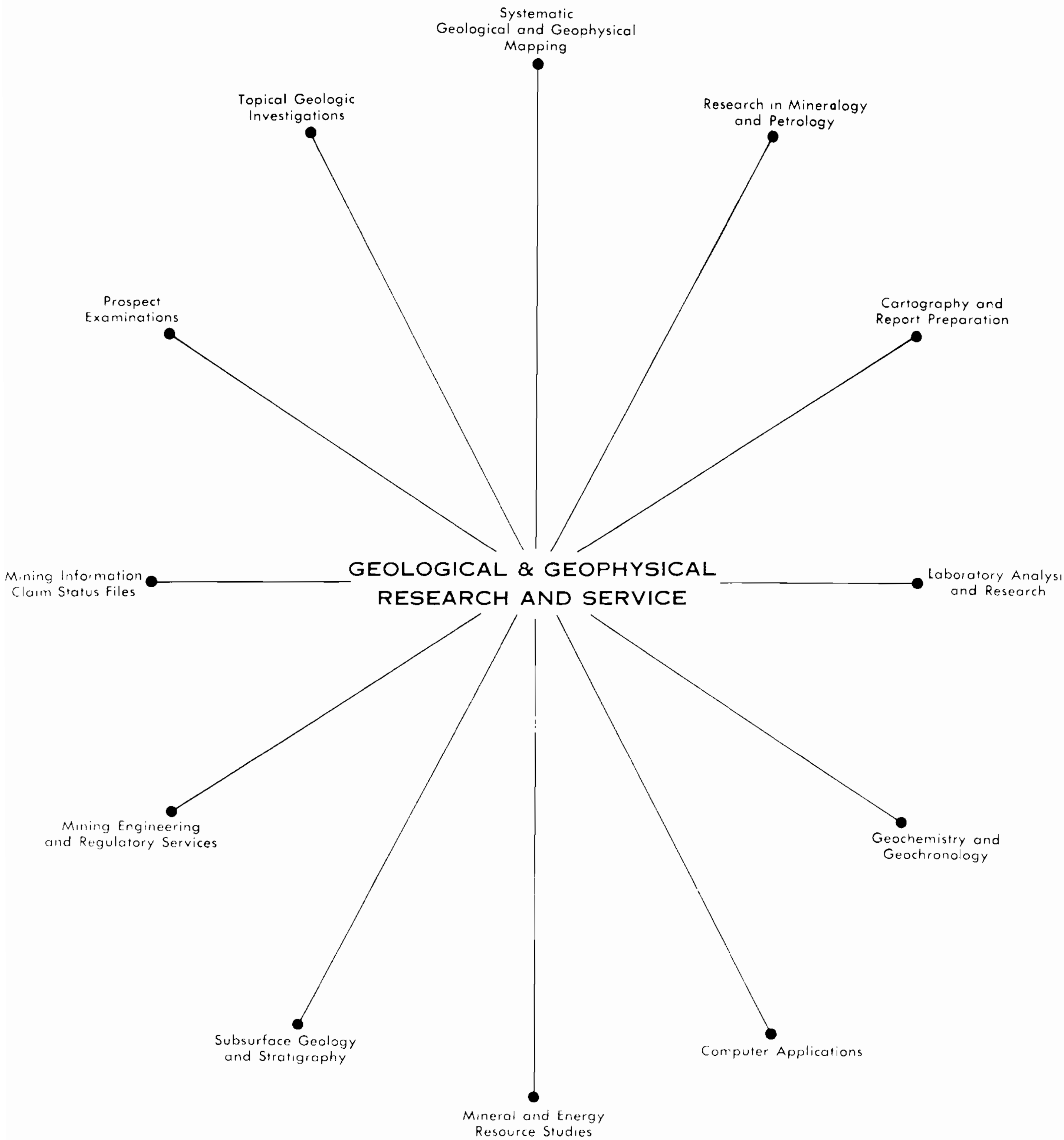

FIGURE 1. Duties of the Division of Geological and Geophysical Surveys

Morehouse, Jeffrey A.	- Geologic assistant[1]
O'Connor, Kristina M.	- Geologic assistant
Pessel, Garnett H.	- Petroleum geologist
Reger, Richard D.	- *Mining Geologist III*
Tosdal, Richard M.	- Geologic assistant[1]
Welch, Joanne K.	- Geologic assistant
Wiltse, Milton A.	- Mining geologist III

MINERAL ANALYSIS AND RESEARCH LABORATORY

Coursey, Nicki D.	- Geochemical analyst
Douglas, Gregory E.	- Lab assistant
Martin, Gail A.	- Lab assistant
Potworowski, Henry S.	- Mineral lab supervisor
Stein, Donald R.	- Assayer
Veach, Namok C.	- Assayer chemist

REGULATION AND INFORMATION

Conwell, Cleland N.	- Mining engineer
Dieterich, Patricia G.	- Mining information specialist[2]
Grose, Earleen L.	- Mining information specialist[3]
McBride, Ulrika (Ona)	- Mining information specialist[4]
Stevenson, Carole H.	- Mining information specialist[2]
Zartman, Geraldine M.	- Mining information specialist[5]

PUBLICATIONS

Larson, L. Frank	- Publications specialist II
Mann, Roberta A.	- Clerk
Renaud, Charlotte M.	- Cartographer II
Robinson, Mona J.	- Clerk-typist
Schell, L.C. (Ann)	- Cartographer I

[2]College office (p. 25).
[3]Juneau office (p. 25).
[4]Anchorage office (p. 25).
[5]Ketchikan office (p. 25).

UA geophysicist Juergen Kienle taking gravity readings in Tordrillo Mountains, south-central Alaska (p. 8). Note granitic spires rimming cirque in background.

RESOURCE INVESTIGATIONS

COOPERATIVE PROGRAMS

An emerging role of the Division of Geological and Geophysical Surveys is the coordination of resource studies. Much of the needed geologic information about the state can be obtained through cooperative and collaborative efforts with federal and state agencies and with private enterprise.

WATER RESOURCES PROGRAMS

During 1974 and 1975, DGGS collaborated with the Geological Survey on a water-resource program within Alaska to prepare a long-range plan for the proper use and development of Alaska's water resources. This project was divided into the following two general categories.

STATEWIDE WATER INVENTORY

The two surveys collaborated on a program of surface- and ground-water data collection, processing, filing, and tabulation. Work expended in this continuing effort included aquifer tests and geophysical logging of selected localities. The project chief was G.S. Anderson[6] of the U.S. Geological Survey. This project will be continued in 1976.

WATER RESOURCES PLANNING

A long-term program to fit the needs of Alaska—including consideration of existing federal, state, and local water-resources programs—was scheduled to be designed by the U.S. Geological Survey in late 1975. In the program, federal hydrologists are to work closely with DGGS personnel in such areas as reviewing the state's legislation, classifying state lands with respect to water resources, and providing input for land-use planning.

R.G. Schaff

REGIONAL GRAVITY MAP OF ALASKA

DGGS and the U.S. Geological Survey completed a cooperative effort in acquiring the necessary data to publish a regional gravity map of Alaska at scales of 1:2,500,000 and 1:1,000,000. DGGS personnel occupied gravity stations in the Cook Inlet area, western Brooks Range, Alaska Peninsula, and Gulf of Alaska during the 1974 and 1975 field seasons. Final map compilation is complete and in press. Project leader is D.F. Barnes[7] of the U.S. Geological Survey.

S.W. Hackett

PETROLEUM INVESTIGATIONS ON ARCTIC SLOPE

Petroleum-related investigations of the Arctic Slope basin and a study of the regional geology of the central and western Brooks Range were carried out in cooperation with the U.S. Geological Survey during the spring and summer of 1975.

COLVILLE-CANNING RIVERS

Regional well correlations in the Colville-Canning Rivers regions were used to produce a series of isopachous and structural maps of the subsurface in this part of the petroleum province. Principal authors were I.L. Tailleur[8] and G.H. Pessel, with participation by K.J. Bird[9] and R.L. Carter.[10] These maps are currently being reviewed for publication by the USGS.

BROOKS RANGE

A DGGS-USGS Arctic Slope field party investigated regional stratigraphy and structure in the central and western Brooks Range, and sampled for organic geochemistry and micropaleontology along the south flank of the Arctic Slope basin. Gravity profiles were established across selected traverses of the northern Brooks Range and the south flank of the basin. Paleomagnetic studies in the Brooks Range and stratigraphic studies of Cretaceous sediments in the basin were also undertaken. The U.S. Geological Survey field party was directed by C.G. Mull[11] and Tailleur.

G.H. Pessel

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[6] Ground Water Division, Anchorage, AK 99501.

[7] Branch of Alaskan Geology, Menlo Park, CA 94025.

[8] Branch of Alaskan Geology, Menlo Park, CA 94025.

[9] Oil and Gas Branch, Menlo Park, CA 94025.

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[11] - do - - - - - - - - - - - - - - - - .

GULF OF ALASKA

The primary purpose of the project, jointly funded and operated with the Conservation Branch of the U.S. Geological Survey, was to measure the thickness of the potential source and reservoir rocks of this area. Secondary purposes of the project were a gravity survey, stream-sediment sampling for base metals, scintillometer readings for uranium, checking for coal, and furnishing the Alaska Department of Fish and Game with an animal count.

Nearly 14,500 feet of vertical section was measured and sampled; another 27,000 feet of lateral sand traverse was completed. Ninety samples were collected for hydrocarbon analysis, 48 for geochemical, and 19 for macropaleontological. Two coal and three oil samples were also taken. Gravity stations were taken on a rough 10-15 mile grid from Cordova to Dry Bay.

Thick sands, 250-500 feet thick, were found on state land in the Yakataga formation—an area that will be a primary target for exploration in the Gulf of Alaska. Oil seeps were resampled at three locations.

State land in the Yakataga area has fair to good reservoir quality in the outcrop. The basal Yakataga formation has the best potential, with about 500 feet of sandstone overlying many oil seeps. Porosity ranges from a few percent to 27 percent.

W.M. Lyle

WESTERN BROOKS RANGE GRAVITY SURVEY

The U.S. Geological Survey and DGGS collaborated on regional gravity surveys over the Kobuk—Ambler lowlands, eastern Baird Mountains, and Schwatka Mountains. Over 150 helicopter-assisted gravity stations were made in the Ambler River, Survey Pass, Shungnak, and Hughes 1:250,000 quadrangles. Another 80 gravity stations were taken while making foot traverses along road systems over the Cosmos Hills, Kobuk, Dahl Creek, and Bornite areas. These gravity data, when compiled with U.S. Geological Survey reconnaissance information, will help in tying together regional bedrock geology, tracing regional structural features and fault systems, defining rock density signatures (if any) of newly discovered copper ore deposits in the Ambler district, and reducing aeromagnetic-data ambiguity.

Geological interpretation of regional geophysical data will be useful for earth-resource inventorying, evaluating, and land-use planning in the western Brooks Range area. The regional survey provide a basic framework for more detailed geological and geophysical investigations.

Helicopter and partial logistic support came from the U.S. Geological Survey.

S.W. Hackett

R.G. Schaff, M.A. Wiltse, and M.W. Henning await helicopter at Arctic Camp, Brooks Range.

W.M. Lyle samples oil seep at north end of Malaspina Glacier, Gulf of Alaska.

GEOCHRONOLOGY PROGRAM

DGGS staff geologists and personnel of the geochronology laboratory of the University of Alaska Geophysical Institute continued working closely in 1974 and 1975.

DOCUMENTATION

Alaska DGGS open-file report 72 by D.L. Turner[12] and T.E. Smith, "Geochronology and Generalized Geology of the Central Alaska Range, Clearwater Mountains and Northern Talkeetna Mountains," was released in 1974. It contains a 1:250,000-scale geologic map with 83 K-Ar mineral ages determined in the geochronology lab.

A report titled "Radiometric Dates from Alaska: A 1975 Compilation" by Turner, D. Grybeck,[13] and F.H. Wilson[14] was published as DGGS Special Report 10. This report contains a computer-produced listing of over 700 published radiometric dates organized by quadrangle, rock type, dating method, and mineral dated.

The Radiometric Age Map of Alaska was also completed. This map, released as a series of open-file reports (AOF 82-86) by Wilson and Turner, consists of a 1:1,000,000-scale enlargement of the five National Atlas Maps of Alaska with plotted radiometric dates and accompanying text. The map includes published-thesis and open-file radiometric data available as of June 1975. Accompanying each map section is a table keying the plotted dates to the more detailed listing in Special Report 10. The map is available either on paper or transparent mylar. Because the bases used are identical, the mylar version can be used as an overlay for the new geologic map of Alaska being prepared by Helen Beikman of the U.S. Geological Survey.[15]

FIELD PROGRAMS

Two cooperative field projects were initiated during the summer of 1974 with DGGS helicopter support: a study of chronology of intrusive activity on the Alaska Peninsula and a study of basement chronology in the Talkeetna Mountains. All necessary mineral separations for these projects have been completed and the analytical work involved in dating was completed in 1975.

Sampling for dating along the south flank of the Brooks Range was continued in 1975 by M.A. Wiltse and M.W. Henning. Turner joined DGGS field parties in the Healy and Kantishna areas for joint sampling. These samples are now being evaluated for dating.

Geochronology of the Craig A-2 quadrangle, the Talkeetna Mountains, Alaska Peninsula, and Livengood areas were also completed in 1975.

D.L. Turner

[12]UA Geophysical Institute, College, AK 99701.
[13]UA Geology Department, College, AK 99701.
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[15]Branch of Alaskan Geology, Menlo Park, CA 94025.

K-AR AND FISSION-TRACK DATING OF VOLCANIC ASH LAYERS IN TERTIARY COAL BEDS ON THE KENAI PENINSULA

In a pilot study completed in 1975, 14 K-Ar and fission-track mineral dates were determined from over 30 ash partings from coals on the Kenai Peninsula. These datings are significant because: 1) they were obtained from type and reference sections for two paleobotanical stages and thus determine chronologic positions of these stage type and reference sections; 2) concordant dates were obtained from as many as three different minerals in the same sample, thus ruling out the possibility of mixed volcanic and detrital mineralogies; and 3) they exemplify the potential value of ash partings in coals for stratigraphic correlation of terrestrial coal-bearing sequences.

Our data establish an age of 8 m.y. (late Miocene) for the Homerian-Clamgulchian Stage boundary in its type section. The early part of the Clamgulchian Stage is thus shown to be Miocene rather than Pliocene, as was previously believed.

This project was initiated by D.M. Triplehorn[16] with DGGS support and later continued by Triplehorn and Turner[12] with support from the Union Oil Company and the U.S. Bureau of Mines.

D.M. Triplehorn

BROOKS RANGE PROJECT

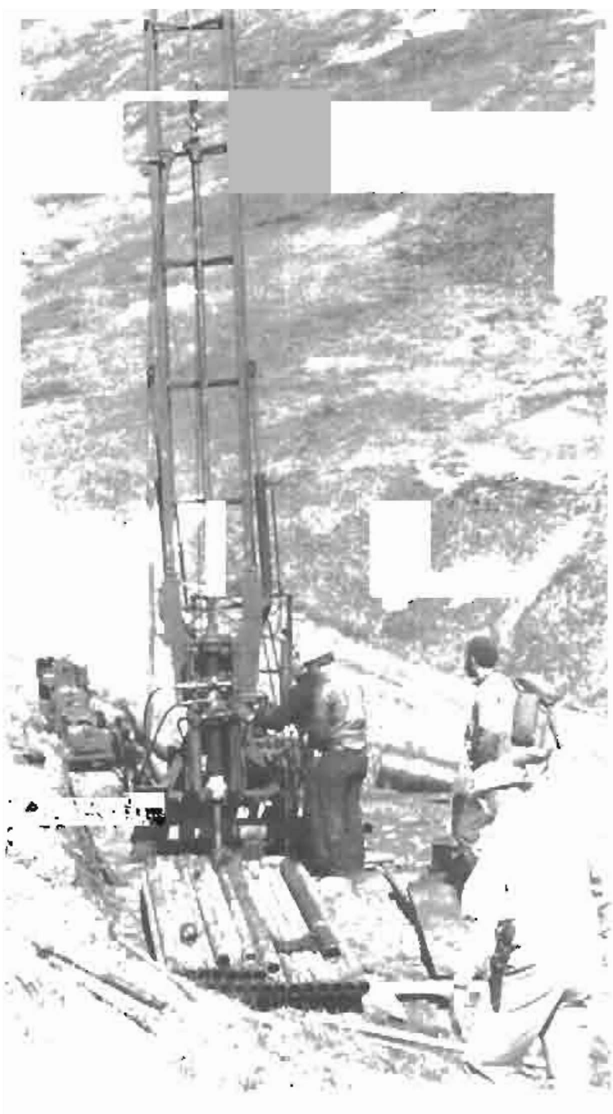
Geologic investigations in the southwestern Brooks Range were continued for the fourth year in 1974 and for the second year as a joint program with the U.S. Geological Survey. The main objective of the project was regional geologic mapping along the plutonic and metamorphic belts in the southwestern Brooks Range. Mapping was continued west from the limit of work done in

[16]UA Geology Department, College, AK 99701.

DGGS camp near Bornite, western Alaska. Bear Creek Mining head frame and exploration camp in background.

1973. Approximately 2,200 square miles were mapped at a scale of 1:63,360 in the southeastern part of the Baird Mountains quadrangle and in the western Ambler River quadrangle (fig. 2). As part of the investigation, approximately 500 stream-sediment samples were collected for geochemical analysis, and 119 gravity stations were established.

The metallogenic belt in the southwestern Brooks Range is now recognized as one of the most important metal provinces in the state. A number of deposits of copper, lead, zinc, cadmium, and silver have been discovered in the Ambler River and Survey Pass quadrangles. In the past 2 years, a claim-staking "rush" continued with thousands of claims filed. Mineralization is common in parts of the Brooks Range adjacent to the metallogenic belt and along the extension of the belt, and prospecting is expected to reveal still more deposits of economic interest.



Diamond drilling at Picnic Creek, Brooks Range mineral belt, northern Alaska.

The field party operated from the village of Kiana, on the Kobuk River, with an FH-1100 helicopter furnished on contract by Merric Inc. of Fairbanks. Personnel included I.L. Tailleur,[8] and W.P. Brosge[17] of the U.S. Geological Survey and G.H Pessel. R.B. Forbes[18] and J.R. Carden[19] worked with the field party for a few days, continuing their investigations of blueschists in the southwestern Brooks Range.

G.H. Pessel

COOK INLET PROJECT

In a continuing effort with the U.S. Geological Survey, DGGS assisted in investigating Cook Inlet onshore and offshore areas from Kalgin Island south to Cape Douglas. First, up to 500 miles of seismic data were acquired. Gravity and magnetic data were also acquired from this area.

DGGS geologic field parties also helped map the Kenai Peninsula around Seldovia and the area from Bruin Bay to Cape Douglas to connect offshore geophysical data to onshore geology. From these data, stratigraphic sections will be measured and regional geologic cross sections will be constructed. The work included sampling for organic-rich rocks capable of generating oil and gas, seals, and reservoir rocks that may be important drilling objectives.

The resultant data will be compiled and distributed in the sections pertaining to the framework geology, and resource appraisal estimates in the final environmental impact statement for the Lower Cook Inlet sale. Project chief was L.B. Magoon[20] of the U.S. Geological Survey.

R.G. Schaff

GRAVITY SURVEY OF TORDRILLO BLOCK, SOUTH-CENTRAL ALASKA

In a joint project with the UA Geology Department and Geophysical Institute, over 200 gravity stations were taken (fig. 2) in 1974 in a previously unsurveyed area west of the upper Cook Inlet (Tyonek and Kenai quadrangles). The area is of great tectonic importance because it contains the junction of the Alaska and Aleutian Ranges, the termination of the Aleutian volcanic arc, the junction of several major fault systems, and Tertiary oil- and gas-bearing sedimentary basins.

Steep gravity gradients revealed for the first time the high-angle reverse nature of the Castle Mountain, Bruin Bay, and Beluga Mountain faults. The Beluga Moun-

[17] Branch of Alaskan Geology, Menlo Park, CA 94025.
[18] UA Geophysical Institute, College, AK 99701.
[19] - - - - - - - - - - - - - do - - - - - - - - - - - - -.
[20] Branch of Alaskan Geology, Menlo Park, CA 94025.

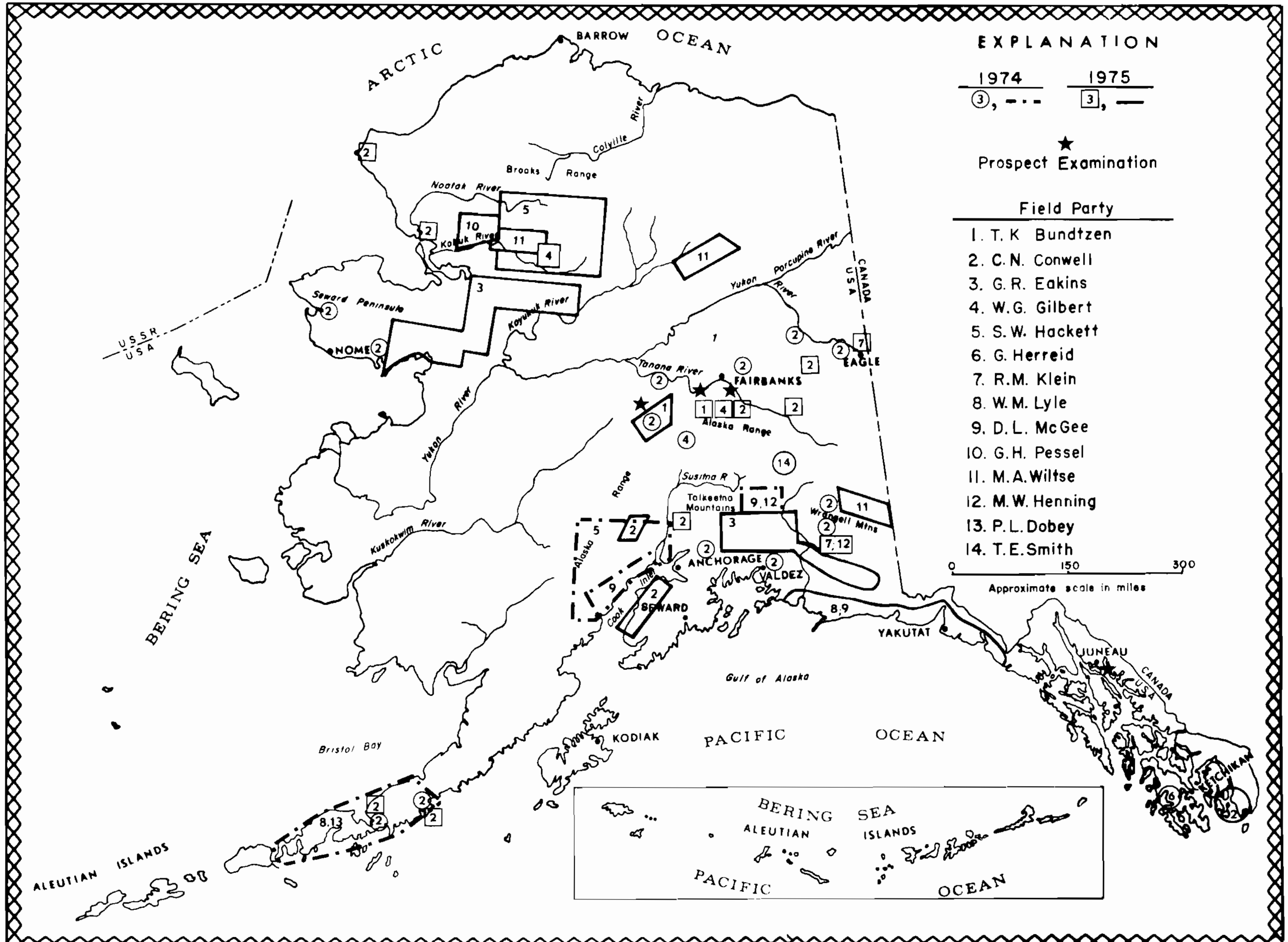


Figure 2. Field studies made by DGGS personnel—1974, 1975.

tain fault is a previously undefined major lineament which coincides with a postulated hinge fault in the subducting Pacific plate. The location of the Cook Inlet, Beluga, Susitna, and Yentna sedimentary basins appears to be controlled by deep-seated basement discontinuities.

The project was directed by J. Kienle.[21] Helicopter support was provided by DGGS.

S.W. Hackett

I.F. Palmer of U.S. Geological Survey samples oil seep at north end of Malaspina Glacier, Gulf of Alaska.

COPPER DEPOSITS OF THE CHANDALAR C-4, C-5, D-4, AND D-5 QUADRANGLES

Fifteen major groups of claims include the most promising anomalous areas in the Chandalar belt of mineralization. The deposits resemble small metamorphosed and deformed porphyry-copper systems developed in and around sill-like bodies that have intruded a Paleozoic carbonate-argillite terrain. The associated meta-igneous rock is a hornblende granodiorite (field term). This rock has undergone intensive shearing for a considerable distance inwards from its contact with the surrounding Paleozoic metasediments. As a result of this shearing, primary igneous textures and mineral assemblages have been completely destroyed in both the smaller intrusions and the marginal zones of the larger meta-igneous bodies. Where this shearing has been extensive, intrusive rocks appear as quartzose chlorite schists. Both field manifestations of igneous rock, however, contain disseminated chalcopyrite, molybdenite, and pyrite.

Small silicious epidote-garnet diopside(?) skarns have developed locally in marbles and appear as thin, irregular masses scattered along the granodiorite metasedimentary contact. Some of the claim groups also contain small pods of massive magnetite localized at the granodiorite contact. Both the skarns and the magnetite bodies contain small concentrations of chalcopyrite that would assay at several percent Cu.

The field investigation was a joint state-federal project. S.P. Marsh[22] directed the U.S. Geological Survey effort.

M.A. Wiltse, M.W. Henning

MORDENITE DEPOSITS AND ZEOLITE ZONATION IN THE HORN MOUNTAIN AREA

Extensive mordenite-rich tuffs occurring with the Talkeetna formation in the Horn Mountain area of south-central Alaska are of commercial grade. The properties of the mordenite with regard to commercial requirements need further study.

The zeolites in the area were formed by burial diagenesis and regional metamorphism of lava and volcanic detritus deposited in a eugeosynclinal trough. Heulandite and laumontite zones suggest that the sediments were subjected to a maximum temperature near 200°C at water pressures from 0.5 to 3 kilobars, which corresponds to burial depths of 1 to 10 kilometers.

The occurrence of mordenite within the heulandite zone is probably due to the fine-grained nature of the parent tuffs, which caused a higher silica activity than elsewhere in this zone, thereby producing mordenite.

Analcime, which occurs locally within the mordenite zone, may have been formed from mordenite or heulandite tuffs by the action of solutions that were more alkaline locally than elsewhere in the zone.

D.B. Hawkins[23]

COMMERCIAL-GRADE MORDENITE DEPOSITS OF THE HORN MOUNTAINS

Zeolitized tuff beds that are 14 kilometers long, at least 30 meters thick, and that consist of about 50 percent mordenite are present in the Horn Mountains. This mordenite-tuff is of commercial grade and shows promise as a sulfur-dioxide sorbent.

Both the individual tuff beds and the entire tuff unit are graded. The double grading implies that the tuff was formed by a large undersea volcanic (dacitic?) explosion.

Mordenite and other zeolites such as heulandite, laumontite, and analcime, which occur in other rock units of the area, were formed by chemical reactions controlled by the composition and permeability of the parent material and the composition of intrastratal fluids. During zeolite formation the volcanic pile was subjected to fluid pressures of 0.5 to 3 kilobars and temperatures less than 200°C.

D.B. Hawkins

[21] UA Geophysical Institute, College, AK 99701.

[22] Branch of Exploration Research, Golden, CO 80401.

[23] Geology Department, University of Alaska, College, AK 99701.

GEOLOGY OF THE RAINBOW MOUNTAIN—GULKANA GLACIER AREA

The Rainbow Mountain—Gulkana Glacier area is located in the eastern Alaska Range near the Richardson Highway between Phelan Creek and the upper reaches of College Glacier. The bedrock in this area is part of the complex terrane that is extensively exposed along the south flank of the eastern Alaska Range. This terrane consists of metamorphic rocks of uncertain age, upper Paleozoic volcanic and sedimentary deposits, middle Triassic greenstones, granitic intrusives of Mesozoic and Tertiary age, and Tertiary nonmarine sedimentary and volcanic deposits. Most of the work was devoted to the upper Paleozoic volcanic and sedimentary rocks to establish late Paleozoic paleogeography and paleotectonics for the eastern Alaska Range region.

The late Paleozoic and Tertiary strata are folded into discontinuous anticlines and synclines with steeply dipping limbs. Fold axes trend northwest in the western part of the area. In the eastern part of the area the folded strata appear to have been rotated counterclockwise, and the fold trend there is dominantly northeast. High-angle, reverse, and thrust faults are common throughout the area, and a major north-dipping reverse fault separates the upper Paleozoic strata from the Tertiary deposits.

The upper Paleozoic strata have been divided into two lithologic successions. The older is named the Tetelna Complex, and it ranges in age from middle Pennsylvanian to early Permian. The Tetelna Complex is overlain by the younger Mankomen Group, which is early to middle Permian and possibly late Permian in age. The two successions are separated by an erosional unconformity.

The Tetelna Complex consists of approximately 35 percent andesitic-basaltic lava flows, 12 percent andesitic pyroclastics, 50 percent dacitic pyroclastics, and about 3 percent rhyodacitic pyroclastics (compositions based on mineralogy). These volcanic rocks are interbedded with feldspathic and lithic sandstones and conglomerates, all of which were derived from volcanic sources. Silicified siltstones, claystones, and fossiliferous limestones also are present. The sediments of the Tetelna Complex were deposited in a moderately deep marine environment in which the principal depositional processes were submarine gravity flows and settling from suspension. Graded bedding, contorted stratification, and submarine debris flow deposits are common throughout the Complex. The nature of many of the pyroclastic deposits suggests that highly explosive Pelean and Plinian eruptions were especially common during deposition of the Tetelna strata. Grain-size and thickness changes in several of the pyroclastic deposits indicate that active vents were located a few miles west or southwest of the map area. The Tetelna Complex probably is part of an extensive succession of strata that accumulated on the flanks of a volcanic arc that was active during the late Paleozoic. The arc may have been similar to modern arcs of the western Pacific, especially those in the Kamchatka and Japanese islands.

D.L. McGee, W.M. Lyle at annual safety course preceding field season - on glacier near Anchorage.

The Mankomen Group consists of well-bedded calcarenites and calcirudites, black argillite, highly fossiliferous argillaceous calcilutites, and bryozoan bioherms. Most of the strata in the Group were deposited in shallow water at or above wave base. Volcanism in the arc had ended by the time deposition of the Mankomen Group began, and volcanic source areas were not present. The Mankomen Group probably was deposited on top of the volcanic arc after it became inactive and subsided.

G.C. Bond[24]

[24] Geology Department, University of California, Davis, CA 95616.

D.L. McGee attaches crampons in field-gear test on Eklutna Glacier.

GEOLOGY OF THE EUREKA CREEK AREA, EAST-CENTRAL ALASKA RANGE

Geologic investigations in portions of the Mt. Hayes A-4, A-5, B-4, and B-5 quadrangles near Eureka Creek reveal a folded and faulted succession of predominantly volcanic rocks ranging in age from pre-Pennsylvanian(?) to Late Triassic. Pre-Pennsylvanian amphibolites and greenschists exposed south of the Denali Highway are unconformably overlain by the Pennsylvanian and Permian Tetelna Complex, a sequence of subaerial dacitic to andesitic volcanics and volcaniclastic sediments. These rocks apparently grade into the predominantly marine limestones and shales of the Mankomen Group exposed at Rainy and Eureka Creeks. Collectively, the Upper Paleozoic rocks are approximately 15,000 feet thick.

A very thick succession of basaltic to andesitic flows and related volcaniclastics of the Amphitheater Group unconformably(?) overlie the uppermost Permian strata. Three formations are recognized. The Paxson Mountain Basalt consists of approximately 9500 feet to subaerial basalts recrystallized to greenstone. The Tangle Lakes Formation consists of approximately 13,000 feet of andesite flows, volcanic tuffs, and tuffaceous sediments. Its marine environment of deposition is evidenced by thin tuffaceous limestones that locally contain Late Triassic pelecypods, and by abundant pillows in the flows. The Boulder Creek Volcanics consist of at least 18,500 feet of slightly recrystallized gray-green basalt interlayered with distinctive amygdaloidal zones. Collectively, the three formations comprise over 40,000 feet of predominantly volcanic rocks accumulated during Triassic time. These rocks form part of a belt along the south flank of the Alaska Range that correlates in age and lithology with similar sequences in the Wrangell Mountains, at Kluane Lake (YT), and on Vancouver Island.

This thick sequence is separated in both time and space from Late Jurassic to Cretaceous argillaceous sediments and volcanics which are correlative with the Gravina-Nutzotin belt elsewhere in Alaska. These rocks in the Eureka Creek area have been regionally metamorphosed to the sillimanite zone in the Late Cretaceous and are part of the Maclaren metamorphic belt. The contact between the relatively unmetamorphosed pre-Jurassic terrane and the highly metamorphosed younger sediments is the Broxson Gulch Thrust fault, a major structural break that extends for a minimum distance of 50 miles along the south flank of the Alaska Range. Stratigraphic and structural arguments suggest that the contact is a faulted unconformity.

Dunite and other ultramafic intrusives of probable Tertiary age along the Broxson Gulch Thrust fault and along the Denali Fault east of the Delta River suggest that faulting and intrusions were broadly contemporaneous—perhaps as recently as post-Late Oligocene. Fossiliferous Late Oligocene(?) sandstones and conglomerate are highly deformed along the Broxson Gulch Thrust fault, and younger conglomerates contain abundant clasts from the ultramafic rocks.

J.H. Stout[25]

DIVISION OF GEOLOGICAL AND GEOPHYSICAL SURVEYS PROJECTS

ALASKA FIELD INVESTIGATIONS

KANTISHNA HILLS

DGGS examined the Kantishna Hills (fig. 2) in the first of a 2-year program to determine the geologic framework and economic mineral potential of D-2 land adjacent to the northwest side of Mount McKinley National Park.

Four major objectives were accomplished in 1975: 1) mapping (1:63,360) of 270 square miles of the Kantishna Hills; 2) completion of 1-mile-interval stream-sediment sampling program and commencement of a rock-chip sampling program; 3) collection of samples for age dating both the Totatlanika Schist and the last regional metamorphic event in the Birch Creek Schist; and 4) updating the gold production figures from this area.

The Kantishna Hills is a geologic terrain of two distinct regionally metamorphosed rock types. The older is the heterogeneous Birch Creek Schist of Precambrian or early Paleozoic age and underlies most of the southern and central portions of the hills. The younger rock, the Totatlanika Schist of Mississippian(?) age, makes up most of the northern Kantishna Hills. The contact between the two rock types is tectonic, possibly a high-angle fault that was modified by later dynamic metamorphism. The Totatlanika Schist contains a thick section of slightly metamorphosed volcanic rocks ranging in composition from basalt to rhyolite. These volcanics are overlain by several thousand feet of carbonates and volcanogenic strata.

The Birch Creek Schist is a complexly deformed metamorphic rock sequence that has undergone at least three periods of dynamic deformation. The last period of deformation generated the broad, northeast-trending antiforms and synforms that are presently the dominant structural features of the Kantishna Hills.

High-angle faults cut the bedrock throughout the Kantishna Hills, and thrusting is present in the southern part. The Kantishna Hills are remarkably devoid of fresh intrusive rock. Only small stocks and dikes, mostly cropping out in the southern part, have escaped regional dynamothermal metamorphism. Most of these have been hydrothermally altered.

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[25]Geology Department, University of Minnesota, Mpls., MN 55455.

Kantishna is a famous antimony-gold-lead-zinc-silver district. Although at least one premetamorphic sulfide occurrence was noted, most of the lode mineralization occurs as structurally controlled, postmetamorphic quartz-carbonate-sulfide veins.

In the southern Kantishna Hills, a distinct horizon of marble, porphyroblastic phyllite, green chloritic schists and phyllite, and graphitic schist was mapped along 14 miles of strike length. Many of the mineral veins in the Kantishna mining district are found in this horizon. Several base-metal sulfide veins were noted in the Totatlanika Schist near the contacts between rhyolitic domes(?) and low-grade tuffaceous metasediments.

The project will be completed in 1976.

T.K. Bundtzen, T.E. Smith, R.M. Tosdal

MT. SANFORD PROJECT, WRANGELL MOUNTAINS

Field work in the Wrangell Mountains was undertaken to measure and map a new Tertiary sedimentary section of volcanic and sedimentary units in the Sanford River valley. The work was conducted in May of 1975.

The lower volcanic unit is possibly Jurassic, equivalent to the Chisana Formation, whereas the upper volcanic unit consists of Wrangell volcanics, Tertiary to recent in age. Conglomerate units contain volcanic and granitic clasts, ranging from pebble to cobble size. The sedimentary rocks, composed of cross-bedded, well-indurated fine to coarse sands, lie unconformably on the lower volcanics; a 1-foot-thick coal bed was observed at the base of the sedimentary unit.

Structurally, the area mapped appears to be a block that has been faulted on the east and west, with a generalized dip to the northeast.

Field work was conducted from a tent camp. Air transportation was by helicopter.

M.W. Henning, R.M. Klein

ALASKA PENINSULA EXPLORATION

This project was a continuation of the 1973 field work. The primary objective was to catalog potential hydrocarbon source and reservoir rock. Secondary objectives were to acquire additional geochemical samples, to begin a gravity survey, to perform scintillometer readings for locating potential uranium areas, and to sample and measure the thickness of coal.

Over 360 samples were taken and about 300 gravity stations were recorded. Two measured sections were completed and over 100 scintillometer readings were taken. About 10 usable samples were collected by D.L. Turner[12] for radiometric age dating.

This program showed 1) that state lands north of the Black Lake area, because of the presence of thick marginal marine and nonmarine sandstones, sandy conglomerates, and conglomerates, have a promising petroleum potential—much greater than that of the Cold Bay area to the southwest, which was also investigated; 2) that the coals of the Herendeen Bay—Chignik area (28 feet in beds up to 8 feet thick) may have commercial promise; 3) anomalous values of copper, lead, zinc, and gold were found in area stream-sediment samples; and 4) higher-than-normal scintillometer readings associated with volcanic and intrusive rocks.

C.N. Conwell returned to the Alaska Peninsula in 1975 to further examine the coal potential and to obtain samples for the U.S. Bureau of Mines national coal data bank.

Helicopter, fixed-wing, and commercial aircraft were used.

W.M. Lyle

URANIUM PROGRAM

Stream sediments, water, and bedrock were sampled for uranium in west-central Alaska and the eastern Seward Peninsula. Included in the 1975 program were the Granite Mountain area, Darby Mountains, Selawik Hills, and the Zane Hills. The southeastern section of the Copper River basin and parts of the Chitina River valley were also sampled under the same program. Radiometric surveys were made in each area with hand-carried scintillometers.

The work was performed under a contract with the U.S. Energy Research and Development Administration (ERDA). The program is a part of a nationwide uranium potential investigation called the National Uranium Resource Evaluation (NURE), being administered by ERDA.

The DGGS laboratory in College (p. 23) is currently analyzing the rock and sediment samples for uranium, thorium, and potassium. Water samples are being analyzed by the ERDA laboratory in Los Alamos, New Mexico.

Final products will include sample-location assay maps for uranium, thorium, and potassium, radiometric maps, petrographic reports based on thin-section studies, and chemical analyses of granitic rocks.

In 1974, ERDA awarded a contract to DGGS for a report based on an extensive geological literature search and the preparation of a 1:1,000,000 scale map of the felsic igneous and nonmarine Cenozoic basins of the entire state. Discussion of geographic regions of the geology pertinent to possible vein-type and sedimentary-type uranium deposits, past investigations for uranium, and the possibility for uranium occurrences in the state were included. The map was done by R.B. Forbes.[18]

G.R. Eakins

EAGLE RECONNAISSANCE SURVEY

The purpose of this study was to provide basic data for the DGGS energy inventory program and to provide natural-resource data concerning future land use and possible future state land selections in the Kandik Basin. The survey consisted of sampling petroleum source and reservoir rock, uranium source and reservoir rock, and potential oil shale areas. Stream and water sampling for uranium was also performed. Field work was completed in late August 1975.

R.M. Klein

COOK INLET BASIN COMMODITIES STUDY

The growing importance of the Susitna area, from the Castle Mountain fault on the south to Broad Pass on the north, led to the initiation of studies relating to the commodities found within the area. Especially important are studies to determine location and accessibility of gravels and building materials.

There has also been a growing interest in coal deposits found within the Kenai formation, known to underlie a large part of the area. Several brief investigations were completed during the summer to determine the feasibility of constructing surficial maps that will aid the orderly development of the area.

D.L. McGee

COOK INLET BASIN SUBSURFACE COAL RESERVE STUDY

The Cook Inlet basin contains numerous beds of coal in the Tertiary Kenai formation. There were sufficient data from exploratory oil and gas wells drilled within this basin to estimate cumulative coal thickness from the town of Wasilla in the northern part of the basin to the southwest end of the Kenai Peninsula. The western limits of well control extend from the Castle Mountain fault zone on the west to the major fault zone along the western front of the Kenai Mountains on the east.

TERTIARY ROCKS

The uppermost bedrock unit exposed in the Beluga-Chuitna area is a sequence of siltstone, claystones, sandstones, and conglomerates that includes beds of subbituminous coal and lignite. Barnes[26] considers these sediments to be a continuation of the Tertiary Kenai formation, which is exposed on the west side of the Kenai Peninsula and separates the Kenai formation in the Beluga-Chuitna area into a lower and middle member. The lower member is a nonmarine gray and yellow sequence of claystones, siltstones, sandstones, and conglomerates that contains little coal. The middle member, which conformably overlies this member and consists of nonmarine claystones, siltstones, sandstones, and conglomerates, contains nearly all the coal reserves.

[26] Barnes, F.F., 1966, Geology and coal resources of the Beluga Yentna region, Alaska: U.S. Geol. Survey Bull. 1202-C, p. 1-54.

QUATERNARY ROCKS

Much of the surface cover in the Beluga—Chuitna—Capps Glacier area is glacial deposits, both morainal and outwash. The Quaternary sediments examined in this study included sands, gravels, and siltstones. Quaternary sediments do not contain significant bedded coals, although detrital coals are common.

PROCEDURE

Coal counts were made in 86 wells drilled for hydrocarbons in the Cook Inlet. Counts were based on electric log data, including information from resistivity, sonic, and density logs. Mud logs were used to verify coal picks from the electric logs. A minimum thickness of 2 feet was used as the lower thickness parameter. The cumulative coal thicknesses obtained from the well counts were contoured for three different depth intervals.

PHYSICAL ASPECTS OF THE COAL

The coal where exposed and sampled in the Beluga-Chuitna area is classified as subbituminous to lignite and is dull black, locally with a slight brown cast and includes a few thin layers and lenses of bright vitrain. The moisture content is high, ranging from 21 to 33 percent, and the ash content is also generally high, ranging from 2.1 to 22.2 percent. Sulfur content is low, generally 0.2 to 0.3 percent. Heating values average slightly more than 10,000 Btu for a composite average of 47 samples.[26] The physical aspects of the more deeply buried coals are unknown, but the average rank would probably be higher because of increased temperatures and pressures.

Speculative coal reserves calculated for the Cook Inlet basin, described without reference to the economics of recovering the coal, are as follows:

Interval (drilled depths)	Speculative coal reserves in place (trillion short tons)
Surface to 2000 feet	0.1
2000 to 5000 feet	0.3
Surface to 10,000 feet	1.3

D.L. McGee

GEOLOGY OF HEALY D-1 QUADRANGLE

A 2-year geologic mapping and geochemical sampling program in the Healy D-1 quadrangle is directed at understanding both the tectonic setting of the area and the controls of mineralization along the north flank of the Alaska Range. Preliminary results suggest 1) that the Buchanan Creek pluton, located in the southern part of the quadrangle, consists of two bodies that are separated by metamorphic rocks, and is not one composite

R.G. Schaff examines core sample of copper prospect at Arctic Camp, Brooks Range.

pluton, as had previously been thought; 2) that the Totatlanika Schist terrain in the northern part of the quadrangle is complexly thrust faulted and is probably allocthonous; and 3) that mineralization in the quadrangle is likely to be related to granitic intrusions, to thrust faulting, or to volcanogenic members of the Totatlanika Schist.

The program is about two-thirds complete.

W.G. Gilbert

GEOLOGIC INVESTIGATIONS IN HEALY C-6 AND MOUNT MCKINLEY B-1 AND C-1 QUADRANGLES

During part of the 1974 field season, a geologic map of the Healy C-6 quadrangle was completed. Important new information includes the discovery of three new Devonian fossil localities, which assist in unraveling the metamorphic history of the north flank of the Alaska Range. Numerous high-angle faults were mapped, confirming the existence of an extensive block-faulted terrane.

In 1975, several days were spent in the Healy C-6 and the Mount McKinley C-1 and B-1 quadrangles checking and extending previous geologic mapping. In particular, the areal extent of the Mt. Galen volcanics was determined. The unit is now known to trend for 19 kilometers across the northern Mount McKinley B-1 and southern Mount McKinley C-1 quadrangles.

W.G. Gilbert

AEROMAGNETIC SURVEY

For the past 5 years, DGGS has conducted aeromagnetic surveys as part of a long-range program to acquire regional geophysical data throughout the state. This is a collaborative effort with the U.S. Geological Survey; the ultimate goal is total aeromagnetic coverage of Alaska. Figure 3 shows USGS-DGGS coverage to date.

A total of 14,800 line miles (at 1-mile spacing) was flown in 1974 for DGGS by the low bidder, Geometrics, of Sunnyvale, CA. This is equal to 10,200 square miles. In 1975, the same contractor flew 8,660 line miles at a 3/4-mile spacing (6,000 square miles). This brought the DGGS total aeromagnetic coverage, since program inception in 1971, to 95,000 square miles—about 18 percent of Alaska's total land area.

The flight lines were flown 1,000 feet above ground level. Magnetic data was collected with a continuously recording proton magnetometer mounted on a twin-engined aircraft (fig. 4); further technical details may be obtained by contacting the DGGS College office.

The final total magnetic field anomalies are printed in red over USGS 1:63,360 topographic quadrangle maps (fig. 5) at a contour interval of 10 gammas. In addition to the maps, the contractor furnished DGGS with digital magnetic tapes of the survey data. The data were digitized and gridded on 3/8-mile centers. The regional magnetic trend was removed by using the 1965 International Geomagnetic Reference Field updated to 1974-75. Areas flown were:

1974 Contract	
Selawik	D-1 - D-4
Baird Mts.	A-1 - A-4
- - do - -	B-1 - B-4
- - do - -	C-1 - C-4
Ambler River	A-1 - A-6
- - do - -	B-1 - B-6
- - do - -	C-1 - C-6
- - do - -	D-1 - D-6
Shungnak Mts.	D-1 - D-6
Survey Pass	A-6, B-6, C-6, D-5, D-6
Hughes	D-6

1975 Contract	
Survey Pass	A-1 - A-5
- - do - -	B-1 - B-5
- - do - -	C-1 - C-5
- - do - -	D-1 - D-4
Hughes	D-1 - D-5

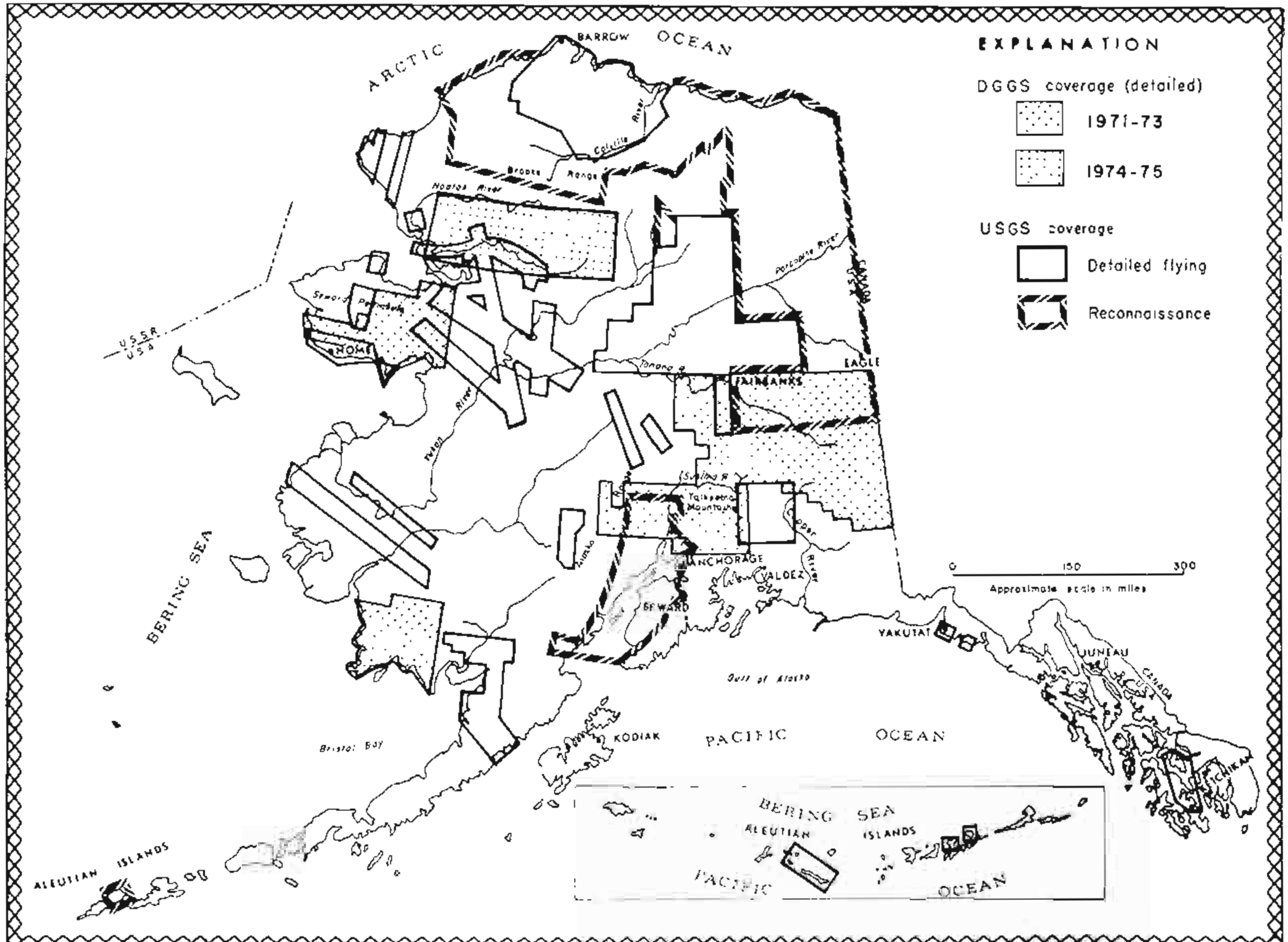
The 1:63,360 aeromagnetic maps are available as soon as completed from any DGGS mining information office (p. 25). They cost $1.10 postpaid or $1.00 over the counter.

Continuation of the aeromagnetic program in 1975-76 will give the state complete coverage of the Ambler River and Survey Pass quadrangles as well as the upper part of the Hughes quadrangle.

S.W. Hackett

BONNIFIELD DISTRICT

Several days were spent in the Bonnifield district, south of Fairbanks, examining the Liberty Bell Mine



Aeromagnetic

Figure 4. Twin-engine aircraft used by Geometrics in aeromagnetic survey. Note magnetometer boom extending from tail.

and other nearby base- and precious-metal prospects. Gulf Minerals Company started a diamond core-drilling program at the Liberty Bell; several other mining companies hold claims in the area.

The Liberty Bell ore body is hosted in the Totatlanika Schist. Ore textures, shape, and mode of occurrence of the Liberty Bell strongly suggest a strataform volcanogenic origin; however, clear-cut quartz-sulfide-amphibole veins apparently associated with porphyry igneous bodies intrude both the ore body and stratigraphy to the north of the mine.

T.K. Bundtzen

STRUCTURAL GEOLOGY OF RUBY RIDGE, AMBLER RIVER A-2, B-2 QUADRANGLES

Field work during 1975 completed the geologic study of Ruby Ridge reported in the 1973 annual report.[27] The area is characterized by compressive tectonic features, including significant imbricate thrust faulting from south to north along the southern mountain front, and the formation of an assymetric arch (Kalurivik Arch), overturned to the north. North of the crest of the Kalurivik Arch are numerous large recumbent folds. The proposed Walker Lake fault, which is projected across Ruby Ridge north of the Kalurivik Arch, is not present in the area mapped. Rather the locus of the proposed fault is marked by an assymetric-to-recumbent antiform and synform, overturned to the north.

W.G. Gilbert, M.A. Wiltse, M.W. Henning

[27] Pages 34-36.

BROOKS RANGE COPPER BELT, SOUTHERN AMBLER RIVER AND SURVEY PASS QUADRANGLES

The mineral deposits within the Brooks Range copper belt, defined as an area approximately 15 miles wide as measured northward from the southern Brooks Range mountain front and bounded on the west by Cross Creek and on the east by the Reed River, are best classified as volcanogenic massive-sulfide deposits.

The sulfide mineralization of each of the prospects studied lies on or only slightly beyond the distal margin of separate domical accumulations of felsic volcanic and volcaniclastic rocks. Both the sulfide mineralization and associated lithologies have undergone regional metamorphism to approximately upper greenschist facies. As a gross generalization, one may envision the sulfide-bearing volcanogenic sequence of lithologies as forming a wedge-shaped prism of rocks that thins to the north, where it probably finally terminates because of nondeposition. The favorable sequence of metavolcanic rocks is thickest along the southern edge of the Brooks Range. The apparent ore potential and the mineralogic complexity of the sulfide occurrences also increase from north to south across the belt. There may be more than one stratigraphic interval of felsic volcanic rocks in the section; however, at least some of the multiple metavolcanic sequences seen in the southern part of the mineral belt have resulted from the repetition of section caused by a superposition of thrust plates.

Potential gross metal values from mineralization within the Brooks Range copper belt are highly speculative at this time, but may range between \$5 and \$20 billion.

M.A. Wiltse, M.W. Henning

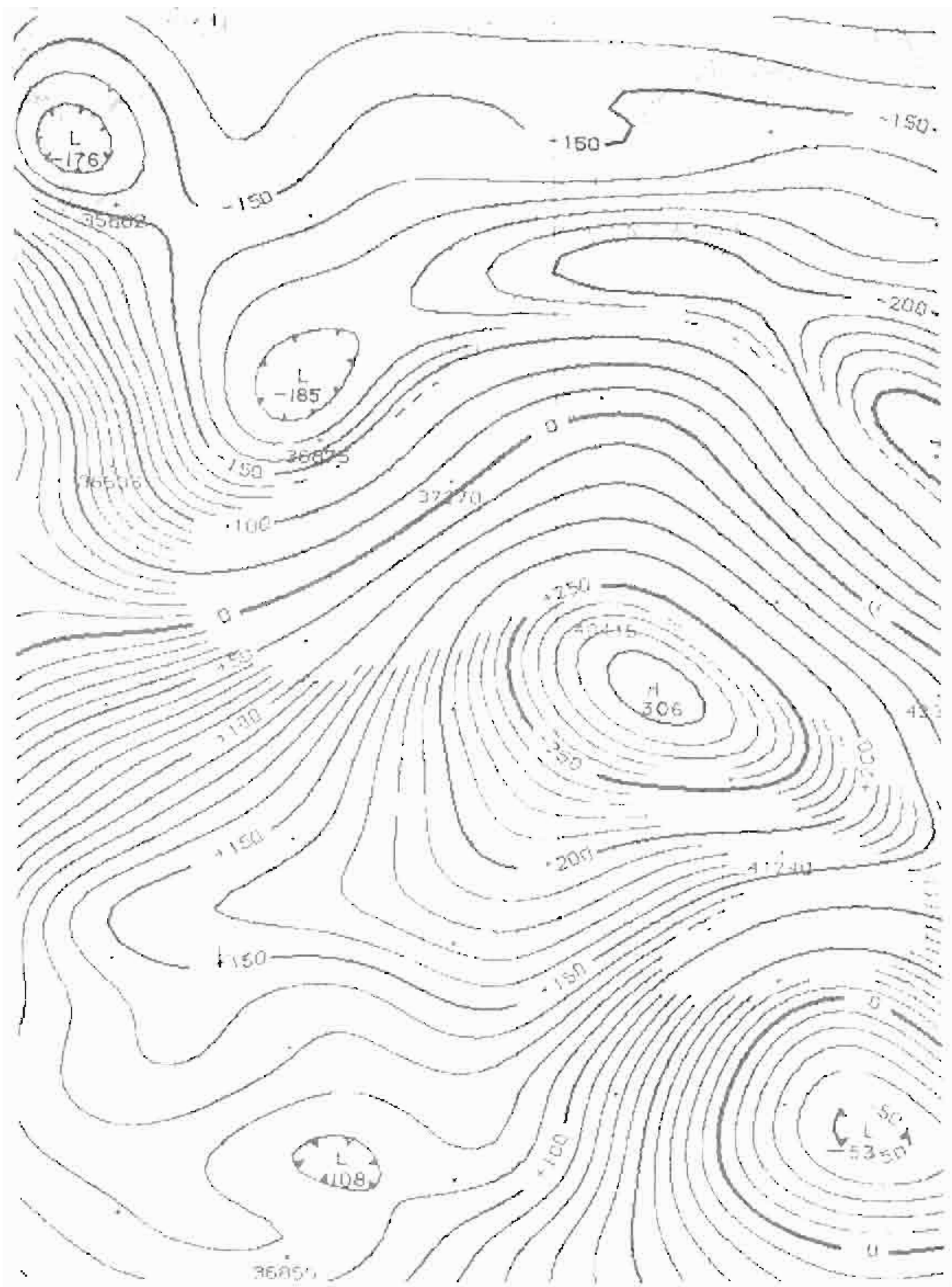


Figure 5. Typical aeromagnetic map, scale 1:63,360.

CRAIG A-2 QUADRANGLE, PRINCE OF WALES ISLAND

The Craig A-2 quadrangle is about 40 miles west of Ketchikan, on the southern part of Prince of Wales Island. It is of interest geologically for its copper deposits and for the large area of Wales Schist, the oldest rock in southeastern Alaska.

During Pleistocene time, the area was covered by an ice sheet. The rounded topography is preserved as accordant ridges and scattered higher mountains underlain by more resistant rocks. Later, valley glaciers carved large U-shaped valleys. A thin layer of glacial till covers most of the bedrock in these valleys.

Throughout the area, 1130 stream-sediment and soil samples and 140 rock samples were analyzed. These show distinct copper anomalies in the stream sediments around Copper Mountain, and a strong lead, zinc, and silver soil anomaly at the Friendship silicified zone. Many other stream sediment anomalies were present—some of which may represent undiscovered mineral occurrences.

The principal ore deposits in the area are contact metamorphic copper-zinc-molybdenum-gold deposits around the Copper Mountain granodiorite pluton, east of Hetta Inlet. There are also two small copper-gold deposits, Corbin and Copper City, along the east shore of Hetta Inlet that are quartz veins parallel to the foliation of the wall rock and about on strike with one another. They could be stratiform volcanogenic deposits.

In the eastern part of the map area, along the south arm of Cholmondeley Sound, there are lead, zinc, and silver veins and disseminations in or near large silicified zones. These are not near plutons exposed at the surface and could be partly remobilized stratiform volcanogenic deposits.

Beautiful epidote and quartz crystals have been mined in all small amounts from the contact metamorphic deposits around the Copper Mountain pluton.

Gordon Herreid

COAL SAMPLING PROGRAM

Samples of coals of Mississippian, Cretaceous, and Tertiary ages were collected for the Coal Research Branch of the U.S. Geological Survey. The USGS is completing a major oxide and trace-element analysis of samples from coal beds in the western United States and Alaska. The objective of this 1975 program was to obtain samples from coal of differing geological ages, particularly in areas not included in current USGS programs. D.M. Triplehorn[16] assisted in the program.

Coal of Mississippian age was sampled in the region south of Cape Lisburne. The coal is low volatile, and may have particular economic significance. (Low-volatile coal in the eastern United States was being sold FOB-mine in 1975 for more than $40 per ton, whereas steaming coals ranged from $10 to 17 per ton.) A washability study will be made on two samples.

Coals of Cretaceous age were sampled in the Herendeen Bay—Chignik Bay area of the Alaskan Peninsula. These beds have a potential for export because the washed coals would have a Btu rating of over 12,000 and they are near tidewater.

Coals of Tertiary age were sampled on the Kenai Peninsula, on the north side of the Cook Inlet, in the Jarvis Creek coal field, and in the Healy coal field. Beds were also examined for ash seams for radiometric age dating.

The Kenai coals are flat lying, close to tidewater, and should be easy to strip mine. The Cook Inlet coal beds are thick (30-50 feet) and are being subjected to an extensive exploration effort by private industry. There has been production from Jarvis Creek in the past; however, the only producing coal area in Alaska is at Healy.

C.N. Conwell

CENTRAL AND WESTERN BROOKS RANGE

Surface geologic investigations of regional stratigraphy and structure, organic geochemical sampling, and gravity profiling were done along the north front of the Brooks Range, from the Anaktuvuk River to the DeLong Mountains. A detailed traverse of the Brooks Range was done in the area of the Alatna and Killik Rivers. The results should be helpful in understanding the geologic history of the Brooks Range and the regional geology of the North Slope basin.

G.H. Pessel

STRATABOUND COPPER-GOLD OCCURRENCE, NORTHERN TALKEETNA MOUNTAINS

A DGGS field party discovered an occurrence of copper- and gold-bearing volcanic rocks in low glaciated hills of the northern Talkeetna Mountains. Metallization is generally confined to a single, near-vertical flow that is discontinuously exposed for over 3,000 feet. Analyses of 10 composite samples over this interval show significant amounts of copper, gold, and silver. Mineralization, although somewhat remobilized, appears stratabound and may well extend beyond the limits of bedrock exposure. Additional exploratory work was recommended.

A miscellaneous paper (p. 45) on this find was released to the public on October 20, 1975.

T.E. Smith

BEDROCK GEOLOGY OF GULKANA C-4 QUADRANGLE AND VICINITY, SOUTH-CENTRAL ALASKA

Reconnaissance studies by T.E. Smith during the 1974 field season have extended bedrock mapping from the Richardson Highway westward along the

Pilot and D.L. McGee in Yakataga area, Gulf of Alaska.

low hills to link up with previous work in the Gulkana D-5 and D-6 quadrangles.[28] Most of the terrain includes low rounded hills or ridges heavily mantled by glacial debris and dense vegetative cover. Bedrock exposures, except on the highest ridges, are comparatively rare and occur primarily as small patches of angular rubble.

Basement rocks in the area consist of greenschists and recrystallized flow rocks of intermediate to mafic composition that extend westward into the northern Talkeetna Mountains, where faunal evidence documents an upper Paleozoic age. This unit is part of an extensive Upper Paleozoic volcanogenic terrane lying between the Border Ranges Fault and the McKinley Strand of the Denali Fault. Greenschists of the unit are exposed near Hufmans and Hogan Hill on the Richardson Highway. Many of the greenschists and foliated lavas contain abundant secondary actinolite and actinolitic hornblende, the mineral separates of which give K-Ar ages of 125-137 m.y. for the latest thermal event.

Intruding the basement sequence between Hogan Hill and Meiers, and underlying most of the lowland in the upper Gulkana River drainage, is a large body of gneissic to foliated quartz monzonite—granodiorite that is locally garnetiferous and porphyritic in perthitic K-feldspar. Rubble crops west of the highway, in an area totalling over 100 square miles, are typically deeply weathered, although fresh exposures can be found in the roadcut near Meiers. Potassium-argon mica ages from that locality are 143-152 m.y.

The central part of the Gulkana C-4 quadrangle west of Paxson Lake is underlain by a hornblende gabbro complex, which forms the prominent hills of Flat Top Mountain and VABM Media. This intrusive complex underlies about 150 square miles, between Twelvemile Creek on the south and Hungry Hollow on the northwest. Compositionally, the rocks vary from hornblende diorite through gabbro to pure hornblendite. Textures are generally nondirectional and range from fine to very coarse grained. Most of those rocks and similar intrusive bodies to the west are thermally or deuterically altered, with plagioclase altered to greenish albite(?) and with occasional epidote veinlets. They include numerous roof pendants and remnants of the greenschist and metavolcanic host terrane, and locally are cut by younger felsic dikes. Potassium-argon ages of hornblende separates from a similar gabbro body 20 miles west are 136 and 139 m.y.

A small exposure of highly vesicular olivine basalt of probable Tertiary or Quaternary age is present at the south end of Swede Lake in the northwest corner of the Gulkana C-4 quadrangle. To the writer's knowledge, this occurrence and another, associated with Tertiary conglomerates on the north flank of the Amphitheater Mountains, are the westernmost expression of Cenozoic volcanism in this part of Alaska.

T.E. Smith

MISCELLANEOUS INVESTIGATIONS

OIL AND GAS

Open-file report 50, Energy and Mineral Resources of Alaska and the Impact of Federal Land Policies on Their Availability - Oil and Gas, by R.M. Klein and others, indicates where oil and gas may be located in Alaska and estimates how much of it can be economically produced. It also discusses the availability of oil and gas lands in Alaska with regard to present and proposed land-use policies. The report has been used by government agencies and industries for economic estimates and planning future programs.

Total petroleum resources are estimated to be 86.9 billion barrels of oil and 410.2 trillion cubic feet of gas.

COAL

Open-file report 51, Mineral Resources of Alaska and the Impact of Federal Land Policies on Their Availability - Coal, by D.L. McGee and K.M. O'Connor, was written to calculate the known and hypothetical coal resources of the State and evaluate the effect of previous and proposed public land withdrawals on this resource.

Total recoverable coal resources are 132.9 billion tons. In addition, hypothetical coal resources are 1.9 trillion tons. Total demonstrated, inferred, and hypothetical coal resources[29] are 2.029 trillion tons.

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[28] DGGS annual report, 1973, p. 3

[29] Demonstrated coal: Estimates of the quality and quantity have been computed partly from sample analyses and measurements and partly from reasonable geological projections.
Inferred: Coal in unexplored but identified deposits for which estimates of the quality and amount are based on geological observations.
Hypothetical: Undiscovered coal that may reasonably be expected to exist in an area under known geological conditions. No consideration is given to the commercial extraction of this coal.

At this time, 82 percent of the total coal potential land is not leasable for coal development, and 83 percent of the total number of scattered coal occurrences (of unknown potential) are found on unleasable land. About 17 percent of the presently available area is found on state patented and tentatively approved land in the Cook Inlet and Matanuska Valley areas. About half of the total coal potential in the state may be closed to private development indefinitely. Nineteen percent may be opened in 1 to 5 years, and 17 percent may be opened in 5 to 10 years.

SEDIMENTARY URANIUM

Open-file report 52, Energy and Mineral Resources of Alaska and the Impact of Federal Land Policies on Their Availability - Sedimentary Uranium, by R.M. Klein, attempts to speculate on the presence of sedimentary-type uranium deposits that the state could contain. Included are sections on where the uranium has a chance of being found, how much there could be, and what effect the Department of Interior's land classification scheme will have on its availability. The report is written in a simple, straightforward manner and is intended for a wide-ranging audience.

ENERGY ALTERNATIVES

Open-file report 75, An Evaluation of Energy Alternatives, Alaska and the Western United States and Review of E.I.S. 74-90, Section F (Energy Alternatives), by R.M. Klein and K.M. O'Connor, was written at the request of the Alaska Outer Continental Shelf (OCS) Task Force and the state Attorney General's Office. It comments on the Alternative Energy Section of environmental impact statement 74-90, issued by the Department of Interior on OCS leasing in the United States. The report has an analysis of energy alternatives in the western U.S. versus massive unrestricted OCS leasing. One of the conclusions is that energy conservation stands out as the most necessary energy alternative for alleviating near-term energy shortages—

R.M. Klein and K.M. O'Connor await helicopter maintenance in Talkeetna Mountains.

even if the OCS leasing program is developed on a crash basis.

ALASKA OIL AND GAS DEMAND STUDIES

Three open-file reports were written for the Alaska Oil and Gas Development Advisory Board in response to AS 38.06, Section .070, which requires that the board shall consider "the existence and extent of present and projected local and regional needs for oil and gas products and by-products, the effect of state or federal commodity allocation requirements which might be applicable to those products and by-products, and the priorities among competing needs."

The three reports are: AOF-90, Present and Historical Demand for Oil and Gas in Alaska, by G.A. Bewley and others; AOF-91, Alaskan Oil Demand, 1975-2000, by G.A. Bewley and P.L. Dobey; and AOF-92, Future Natural Gas Demand, by P.L. Dobey and others. The results indicate an increasing demand for oil and gas in Alaska with adequate petroleum feedstocks available for a number of future industrial uses. Demand for gas will begin to be critical with respect to royalty availability at the end of the century unless new royalty sources are on line.

Mt. Redoubt in Chigmit Mountains, northern Aleutian Range. Note the two summits separated by a collapsed caldera.

MINERAL ANALYSIS AND RESEARCH LABORATORY

EXAMINATIONS

The staff of the mineral analysis and research laboratory, located in College, performed 10,062 determinations on 2033 samples in 1974. This includes 669 public samples (a 40-percent increase over 1973), 330 DGGS samples, and 1034 geochemical samples. During the first 9 months of 1975, a total of 1476 samples, covering 4401 elemental determinations, were analyzed. This total does not include 466 public samples. In addition, the lab started analyzing 1500 Energy Research and Development Administration (ERDA) samples collected during August 1975; these will require an additional 4500 determinations.

During the past 2 years, overall prospecting efforts were down somewhat, with the major small-prospector effort switching to gold and gold-associated ores.

The sample load at the DGGS assay office reflected opposing pressures on the small operator. On one hand, there were generally increasing markets and prices for most ores and metals. Gold prices sparked a significant revival of gold prospecting and an immediate upsurge in placer activity (lode production normally takes much longer because of the necessary exploration and development). However, the miner had a smaller area in which to prospect because of Native land claims and federal withdrawals; he also had to contend with inflation. (Another factor in the downward trend of prospecting was lucrative employment on the trans-Alaska pipeline, which attracted the small prospector—who is normally skilled in equipment operation.)

Assayer chemist N.C. Veach uses X-ray diffractometer to determine internal structure of minerals. X-ray emission spectrograph in foreground.

NEW EQUIPMENT

For the uranium program (p. 36), ERDA loaned DGGS two instruments: 1) an Aminco-Bowman ratio-spectrophotofluorometer for determining the presence of uranium, tin, aluminum and boron in silicates, and 2) a Model-25 Beckman spectrophotometer.

The lab purchased several items during 1974 and 1975, including a solid-state amplifier for their DMS-31 X-ray unit and an automated sample changer and data-recording system for the atomic absorption instrument. Included in the latter equipment were an IM-6 digital amplifier, an Auto-50 sample changer, and a DP-30 digital printer, which will allow for the eventual automated sampling and data recording of atomic-absorption measurements. The lab also acquired a Westinghouse electrodeless-discharge-lamp (EDL) power supply and the EDL's for arsenic, lead, and tin.

METHOD DEVELOPMENT

For the ERDA program, the laboratory adapted two procedures of Korkisch for the rapid determination of both thorium and uranium in silicate rocks and stream

H.S. Potworowski runs samples through ion-exchange column to determine thorium.

sediments.[30]

The Korkisch methods supplanted the historically lengthy precipitation and separation steps used in the determination of thorium at the ppm level. The new method consists basically of three stages: 1) digestion of the sample in HF/HNO_3, 2) column ion-exchange separation, and 3) color development. The number of chromatographic columns was increased from 20 to 40, and now 80 samples a week can be processed—a marked improvement over the 10-15 samples per week done by standard procedures.

A satisfactory technique for assaying platinum is in the final stages of development. Platinum is put into solution with aqua regia; the oxidant is then removed with urea, and the platinum, reduced by stannous chloride, is extracted into DIBK with Aliquot 336 for analysis by atomic absorption.

[30] Korkisch, J., and Dimitriadis, D., 1973, Anion-exchange separation and spectrophotometric determination of thorium in geological samples: Talanta v. 20, p. 1199-1205.

REVIEW OF ALASKA'S MINERAL AND ENERGY RESOURCES: PRODUCTION AND ACTIVITY STATISTICS

The regulation and information section has several basic functions—conducting geological studies of potential mineral targets, performing prospect examinations, and administering the regulatory provisions of the Alaska Mine Safety Code for coal, metallic, and nonmetallic mining (including all underground construction activities). The regulation and information section also maintains the DGGS mining information offices:

1) College - Second floor, UA Physical Plant Building (P.O. Box 80007, Zip 99701).
2) Anchorage - 323 E. 4th Ave. (Zip 99501).
3) Juneau - Eleventh floor, State Office Building (Pouch M, Zip 99811).
4) Ketchikan - 205 State Office Building (P.O. Box 2438, Zip 99901).

In addition, all lease-mineral mining programs are reviewed—particularly coal mining—to ensure that adequate provisions are made for conservation of the natural resource and that the land will be returned to a condition that is in harmony with the natural environment. The conservation section also cooperates with other state and federal agencies in ensuring that the requirements of the law are met.

GENERAL ACTIVITIES

In 1974, 14 coal and 10 metallic and nonmetallic mine inspections and prospect examinations were completed. One week was spent with the Department of Highways on special problems related to underground construction in reducing the flow of water in the highway tunnel near Valdez. In September 1974, one fatality occurred at a mercury mine near McGrath. Bob Lyman was killed when he was thrown from the tread of a tractor and his head struck the dozer blade.

In 1975, 14 coal-mine inspections, one metal-mine inspection, and one mineral preparation test were completed. One inspection for compliance with a mined-land reclamation project was completed, and two site-inspection exploration programs were concluded. A cooperative program was established with the U.S. Geological Survey to evaluate the coal resources in Alaska. Samples were obtained from seven different coal fields in the state.

In May 1975, Cecil Lester was killed in a coal-mine accident when he was crushed between the ripper tooth of one Cat and the blade of the following Cat. The accident occurred at the Usibelli mine, near Healy.

MINERAL EXPLORATION

Hard-mineral investigations took place in 1974 at about the same pace as in 1973. The major oil companies continued to dominate exploration in the lesser known areas of the state, and the major mining companies concentrated on the known potential mining areas. Physical exploration was limited mainly to diamond drilling. A survey of major companies indicated that less than 35,000 feet of exploratory drilling for hard minerals was completed in the state. Over 50,000 feet of core and noncore drilling was completed in exploration for coal. Noranda completed some drifting to explore gold veins near Chandalar. Geneva Pacific drifted following a showing of chalcocite (copper ore) near McCarthy. As in 1973, the primary effort was directed toward deposits containing copper, nickel, coal, and iron in quantities large enough for surface mining. However, there was indication of interest in nonmetallic ores—particularly barite—and a definite increase in the exploration of coal deposits.

Mineral exploration in 1975 accelerated. There were four very definite trends: 1) major mining companies shifted their emphasis from disseminated deposits to volcanogenic massive-sulphide deposits; 2) exploration for placer deposits increased, both onshore and offshore; 3) uranium exploration increased; and 4) mining, oil, and public utility companies increased their exploration for coal deposits. Several companies conducted major drilling programs for hard metals, gold, and coal. The amount expended on exploration jumped from \$6 million in 1974 to over \$15 million in 1975—apparently because several companies were carefully evaluating by physical exploration the discoveries of previous years. There also appears to be a possible shift in geographic exploration from British Columbia to Alaska because of new principal laws, taxes, and regulations in that province.

An indicator of exploration activity is the number of mining claims filed and maintained. The number of new mining claims filed in 1974 was 10,623, compared to 5,920 in 1973. The number of affidavits of labor was 1,547 from 1974 versus 1,170 for 1973. The active claims in the state increased from 26,580 in 1973 to 34,914 in 1974.

The computation of new claims filed for 1975 is incomplete, but as of November 28, 1975, the total was 11,383; there were 2,225 affidavits of labor and the number of active claims in the state was 47,868.

The College office maintains a list of Alaskan companies and prospectors considered to be active in 1975. This list is available as Information Circular 7 and may be obtained on request.

A regional breakdown of exploration expenditures follows. Figure 6 shows the dollar volume of exploration from 1959 to 1975.

ARCTIC ALASKA

Of the $6 million spent on mineral exploration in 1974, about one-third was invested in exploring for the high-grade copper-lead-zinc ore bodies north of Kobuk in the southwestern Brooks Range. One copper deposit in this area has been evaluated as containing metal worth more than $2 billion. Other deposits along the trend may easily be five times this value.

Intensive claim staking along the copper trend was made by Sunshine and by Watts, Griffis, and McQuat (WGM) in 1974. Detailed field work and core drilling of copper prospects was carried out by Sunshine. Bear Creek continued their development core-drilling program in this district. Elsewhere in the Arctic region in 1974, Noranda drove an exploratory drift on the Little Squaw lode gold property near Chandalar, and

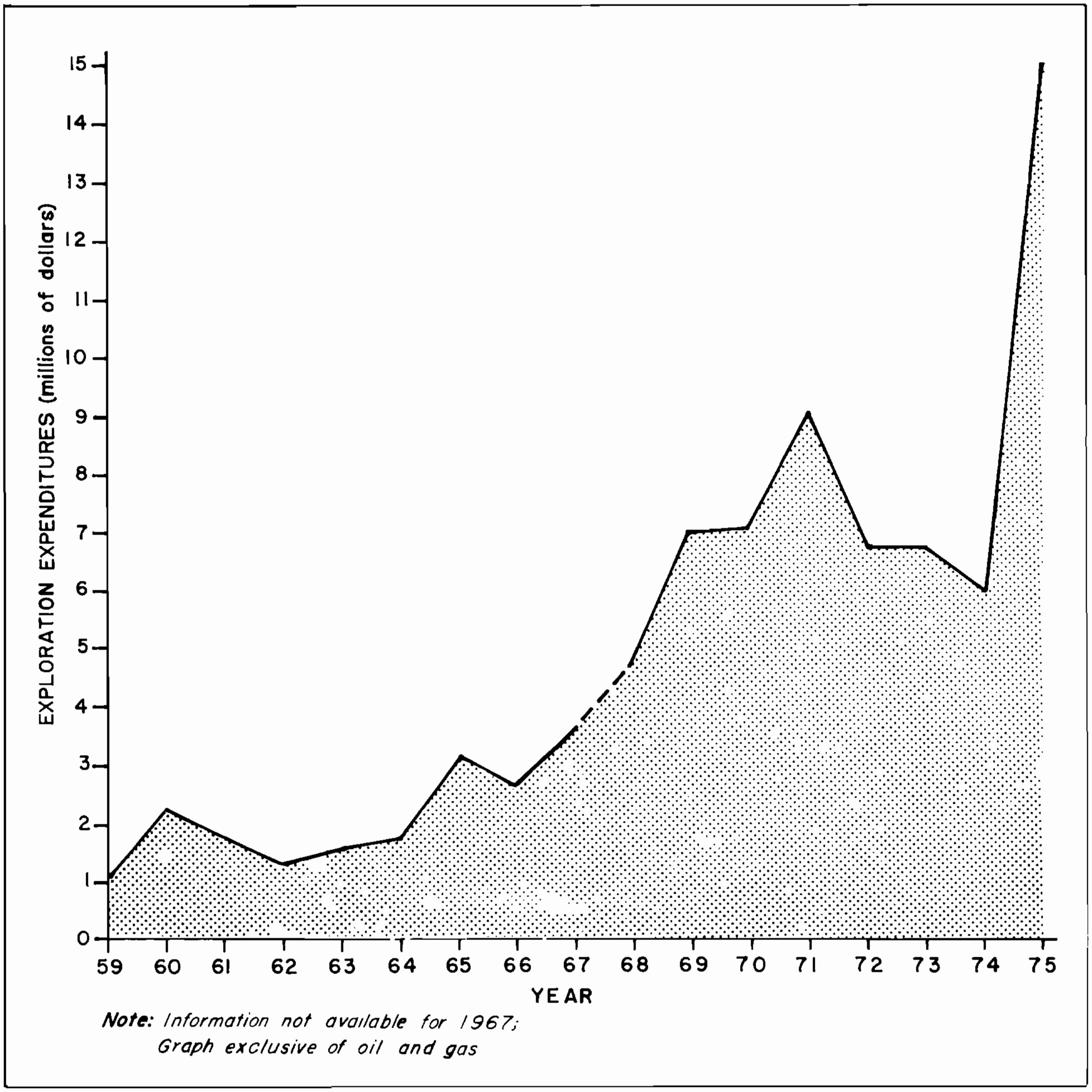

Figure 6. Estimated exploration expenditures in Alaska.

UV Industries drilling thaw pattern at Nome. Dredge in center.

several companies conducted reconnaissance exploration for copper, gold, and lead-silver deposits.

Expenditures for exploration in the Arctic totaled more than $6 million in 1975. Most of the increase was due to intensified exploration in the Survey Pass and Ambler River quadrangles, where extensive deposits of copper, zinc, lead, and silver ores were discovered in 1973 and 1974. Sunshine sold a major interest in its Alaskan holdings to Anaconda, which then assumed an aggressive role in mineral exploration in this region. Others were Kennecott, U.S. Steel, WGM, and Union Carbide. Callahan joined Noranda in the development of gold properties in the Chandalar Lake region, and was named the operating partner. The exploration effort continued outlining the potential ore reserve.

Senator Ted Stevens, recognizing the importance of mineral production and realizing the extent of federal withdrawals of land, obtained federal funds for an appraisal of the mineral potential of the Brooks Range. The funds were administered through the U.S. Bureau of Mines and a contract was issued to WGM, an Anchorage-based consulting firm.

WESTERN ALASKA

Expenditures for exploration in western Alaska were about $200,000 in 1974. Lost River Mining, which has a potentially minable reserve of fluorite, tin, and tungsten ore, had an exploration effort that was limited to surface geology; however, the exploration program was halted until a mining and shipping system can be established and a town and other facilities can be built. PCE conducted an exploration program on the Kougarok River for placer gold. Asarco continued exploration on an offshore gold placer near Nome and conducted marine-science studies for an environmental impact statement.

The level of mineral exploration increased in 1975 to an estimated $500,000. There was a shift in emphasis from tin and gold to uranium. The major efforts were by Urangesellschaft and Resource Associates for an undisclosed client. Other companies that were reportedly active in uranium exploration were Westinghouse, Union Carbide, and Mobil Oil.

The 1975 effort of Lost River was limited to assessment work and exploration directed toward patent of some claims. Asarco continued to probe for gold along the beach at Nome on the edge of the Bering Sea. After obtaining a permit from the U.S. Army Corps of Engineers to remove 100,000 cubic yards of beach material, Asarco operated a barge with a small pilot plant to evaluate recovering of gold in the offshore area. The research effort was to further refine the mineral preparation techniques for gold recovery.

INTERIOR ALASKA

About $800,000 was spent on mineral exploration in the interior part of the state in 1974. Klondike Placer Gold continued extensive preparations for reactivating a major gold-dredge operation at Livengood. Inspiration continued drilling in the large, low-grade porphyry copper deposit at Bond Creek, near Nabesna. Brown and Root completed about 15,000 feet of exploration drilling at Orange Hill. Many prospectors were active in the Kantishna district, north of Mt. McKinley.

At Healy Creek, Usibelli blocked out new coal reserves while producing 700,000 tons of coal in 1974. They have delineated nearly 500 million tons of minable coal in the Healy-Lignite Creeks area. One of the notable features of the Usibelli operation is their ongoing reclamation project, in which strip-mined land is reseeded, providing Dall sheep with a popular pasture area.

AMAX took over the coal-prospecting permits of Inspiration north of Lignite Creek and took an option on the Usibelli properties. In the fall of 1974 AMAX started an exploration program to evaluate the permits. The program was terminated before the severe winter weather started.

At the Purkey property southwest of Mt. McKinley, a Seattle group continued core drilling in a search for lode tin deposits. Near Aniak, J.R. Wyle of Aptos, California, continued exploring his mercury claims and experimented with a small concentrator to recover cinnabar.

There was considerable prospecting and drilling in the Fortymile district by Rioamex, Amoco Production, and others in 1974. Near Paxon, Ranchers Development was actively exploring for placer gold. Other companies known to be active in the interior were Gulf Minerals, U.S. Steel, Rio Tinto Canadian Exploration, Exxon, Cities Service Minerals, and Resource Associates.

In 1975, increased coal exploration by AMAX raised the exploration expenditures in the interior region fourfold. Estimated expenditure for the interior region was $3.5 million. AMAX, which used seven drills in exploring for coal during the summer, exceeded the exploration effort of Ranchers Development.

Other 1975 exploration programs included a uranium search of the Tertiary sediments near Jumbo Dome by Resource Associates. Active companies included Gulf Minerals, U.S. Steel, Rio Tinto, and Cities Service.

SOUTH-CENTRAL AND SOUTHWESTERN ALASKA

In 1974, about $200,000 was spent on hard-mineral exploration in these regions. Semco maintained a field party to evaluate 131 claims covering 2,600 acres of gold property off the southwest flank of Mt. McKinley.

Ranchers Development drilled the Golden Zone prospect near Cantwell in an attempt to block out commercial ore deposits of gold, copper, and associated metals. Considerable exploration activity was reported in the Talkeetna Mountains region in 1974 by U.S. Steel and Cities Service, among others.

On the Alaska Peninsula, Phillips Petroleum conducted surface geological and geophysical work for copper mineralization near Perryville, reportedly in cooperation with the Bristol Bay Native Corporation; Skelly Oil was apparently active in mineral exploration in that region also. In the southwest, Quintana Minerals was working in the Pavlof Bay—Stepovak Bay area. Crandall and Manga continued work on Unga Island.

Exploration for coal in the south-central region increased in 1974. Placer AMEX continued a drilling program to outline coal resources on their lease in the Beluga—Chuitna River area. Shell, Mobil Oil, and Inspiration were also active in the Cook Inlet region. Portland General Electric, a newcomer to the Alaskan scene, was granted a large block of coal-prospecting permits in the Peters Creek area, west of Talkeetna, and completed a limited amount of drilling in November. (PGE intends to mount an aggressive exploration program for steaming coal for their electric plants in Oregon; they expect to mine up to 6 million tons of coal per year.)

SOUTHEASTERN ALASKA

In 1974, nearly $2.8 million was expended on exploration programs in southeastern Alaska. At least eight companies conducted either core drilling or geologic reconnaissance work. Phelps-Dodge drilled for copper on Coronation Island, U.S. Borax drilled on Prince of Wales Island, and Amoco Production, Cominco, Homestake, and Texas Gulf Sulphur conducted geological and geochemical reconnaissance work in various parts of southeastern Alaska.

The large nickel-copper deposit at Glacier Bay, which had been delineated by Newmont in previous years, remained inactive pending resolution of whether mining will be allowed within National Monument boundaries; this may prove to be the largest nickel deposit in the United States. Inspiration began an extensive drilling program to further delineate the nickel-copper deposit on Yakobi Island.

Plans to mine the enormous low-grade magnetic iron deposits at Klukwan, 26 miles northwest of Haines, continued to fluctuate. At last report, Mitsubishi of Japan had apparently dropped their option to develop

C.N. Conwell on reclaimed strip-mining area of Usibelli Coal Company, Lignite Creek - August 1974. Area seeded by aircraft in May 1974.

this property, probably because of a combination of costs, lack of local fuel, and a possible conflict with environmental interests.

In 1975, exploration appeared to decline. Cities Service and Cominco American continued to field reconnaissance geology parties. El Paso maintained a full staff of geologists and geochemists in Ketchikan and worked from Ketchikan to Glacier Bay.

The Cotter Company, backed by Edison Electric, made radiation tests on the following claims: Dotson's Adams and Ross, Chuck Keller's, and I & L. A U.S. Geological Survey geologist from Denver spent 2 weeks in the Kendrick Bay on uranium properties.

James Walper continued working on the Puyallup Extension and plans an aerial reconnaissance on mineral properties on Chichagof Island and magnetic work on Maybeso and Harris Creek. U.S. Borax maintained camp at McLean Arm and a large camp at Smeaton Bay.

Homestake reportedly negotiated for and conducted feasibilities studies on the Alaska Juneau Mine. The company had an active exploration program in southeastern Alaska during the summer field season. Marcona examined an iron ore deposit near Snettisham.

In 1975, the exploration effort for hard minerals continued at the same level as in 1974. The same companies continued reconnaissance exploration. There were no known drilling programs.

Statewide exploration for coal dramatically increased in 1975. AMEX continued both core and noncore drilling in the Chuitna River area, with three drills in operation most of the summer. The drilling was in detail to establish reserves and to design mining methods.

PGE had a coal exploration field party near Peters Creek. Other companies that were active included Shell and Mobil Oil. The U.S. Geological Survey had a field party in the northern part of the Susitna Basin, in the arctic coal fields, and in the Bering River coal field. A DGGS field party sampled coals in the Port Moller, Kenai, and Susitna Basin areas in a cooperative program with the USGS (p. 34). The exploration effort on the coal resources alone probably exceeded $3.5 million.

C.N. Conwell

C.N. Conwell on reclaimed strip-mining area on Healy Creek - August 1974, second year's growth.

MINERAL PRODUCTION

The total mineral production in Alaska in 1974 is estimated at $434 million, compared to a revised estimate of $329 million in 1973. The revised estimate is based on statistics compiled by the U.S. Bureau of Mines. Crude oil and natural gas from the Kenai Peninsula and offshore Cook Inlet field once more were the leading commodities, accounting for $370 million, or 85 percent of the total mineral production.

Other mineral commodities which accounted for $64 million, in order of value were: sand and gravel, stone, coal, barite, gold and silver, platinum-group metals, antimony, mercury, gemstones, and tin. This is an increase of 35 percent over the adjusted figure of $47 million in 1973 (fig. 7). The principal increase was in the undistributed section, which includes platinum-group metals, mercury, gemstones, and tin. The increase in gravel was a pipeline impact.

Value of total mineral production in Alaska in 1975 is estimated at $444 million, up $10 million from 1974. Crude oil and natural gas from the Kenai Peninsula and offshore Cook Inlet field once more were the leading commodities, accounting for $378 million (85 percent) of the total. Mineral commodities constituting the remaining $66 million, in order of value, were: sand and gravel, stone, coal, gold and silver, barite, platinum-group metals, antimony, mercury, gemstones, and tin. This is an increase of $2 million, or 3 percent (fig. 7). The principal decrease was in the undistributed section.

Sand and gravel, stone, and gold continued to increase. The increase in gold production reflects the production for part of the season by the operation of the dredge at Nome and the nonfloat operation at Livengood.

Statistics shown in table 1 were prepared under cooperative agreement between DGGS and the U.S. Bureau of Mines for collection of mineral data. Production of the major commodities since 1950 is listed in table 2. The fiscal amount of Alaska mineral production is listed in table 3. The production figures for 1973 were revised on the basis of information collected by the U.S. Bureau of Mines and DGGS, and are the best estimate of production for the year; the coal and barite figures are DGGS estimates.

Annual production in Alaska (excluding oil and gas) from 1900 through 1975 is illustrated in figure 7. Figure 8 indicates the approximate location of mineral deposits that were in production at least part of the year and deposits where there was an active exploration program. There undoubtedly were prospectors and miners active in other areas, and the figure should be

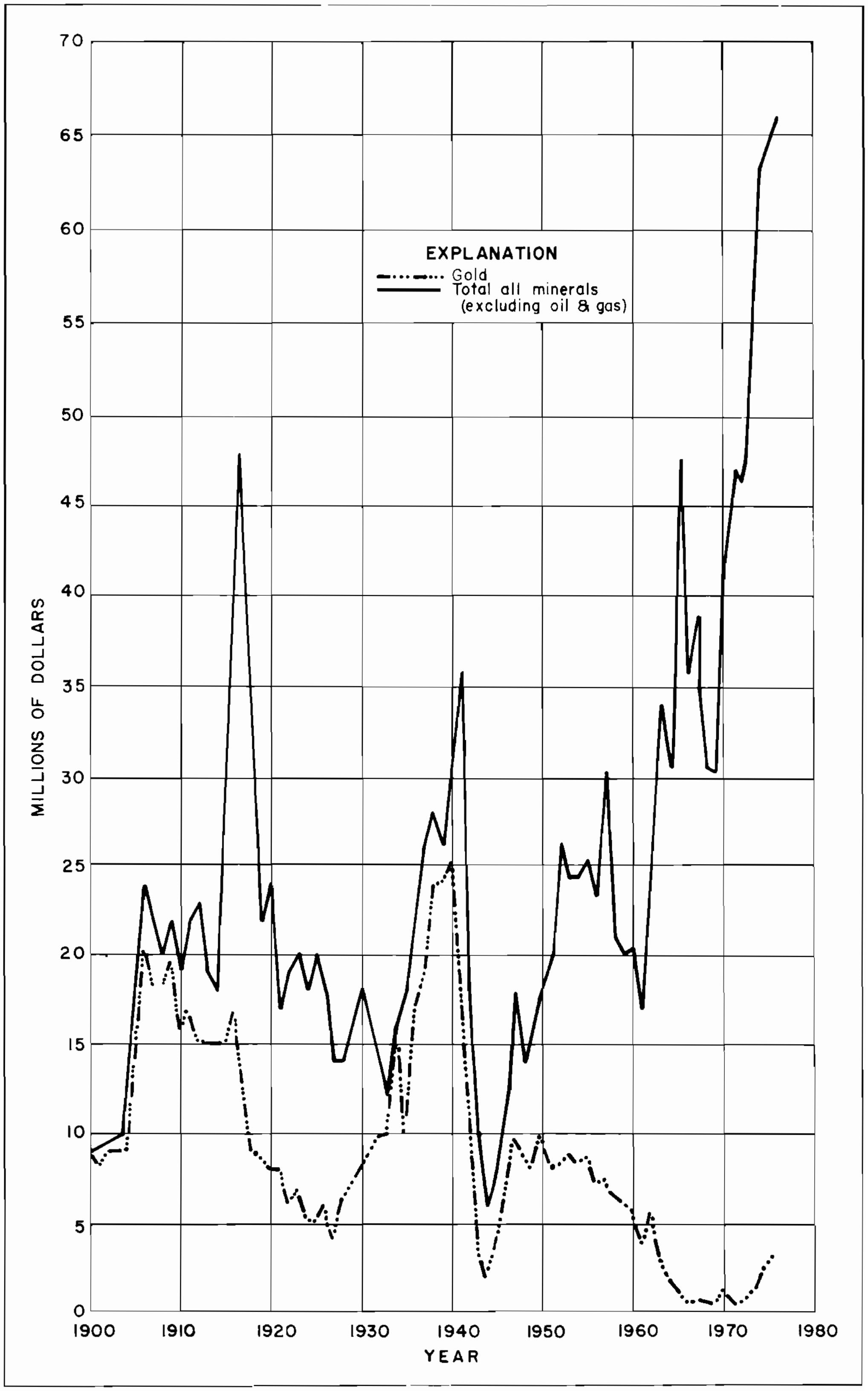

Figure 7. Annual mineral production in Alaska, 1900-1975.

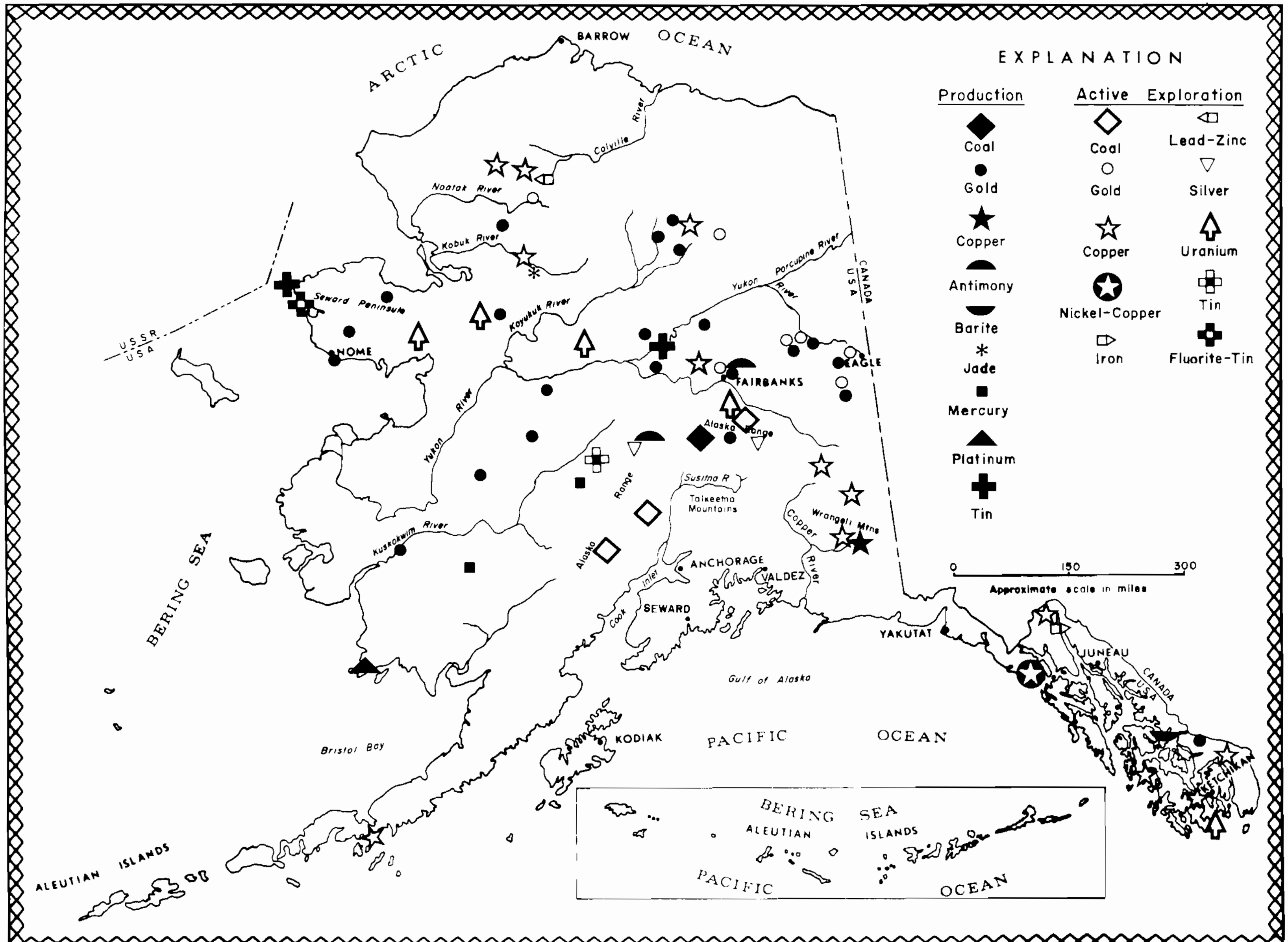

Figure 8. Location of mineral exploration and production—1974, 1975.

Table 1 *Mineral production in Alaska ("Value" columns in thousands of dollars)*

Mineral	1973 Quantity	1973 Value	1974[a] Quantity	1974[a] Value	1975[a] Quantity	1975[a] Value
Antimony - short-ton antimony content	210	108	40	68	60	100
Barite - thousand short tons	b	b	110	1,700	112	1,895
Coal - thousand short tons	b	b	700	7,325	710	7,810
Gold - troy ounces	15,000[c]	1,875	1,600	2,560	2,278	3,349[c]
Stone - thousand short tons	5,967	12,741	5,521	12,886	6,078	14,186
Natural gas - million cubic feet	131,007	19,483	126,034	22,505[d]	141,158	29,643[d]
Petroleum crude - thousand barrels	72,323	261,817	72,244	347,409[d]	71,311	347,500[d]
Sand and gravel - thousand short tons	14,999	19,913	18,740	24,936	22,488	37,404
Silver - thousand troy ounces	2.4	> 6	>1	>1	>1	>1
Undistributed	e	12,846	e	14,495	e	1,731
TOTALS	XXX	328,789	XXX	433,884	XXX	443,618

a. Figures for 1974 and 1975 are preliminary.
b. Figures withheld to avoid disclosing confidential data of individual companies.
c. Gold production estimated from information from producers in various districts. Many individual producers did not respond to U.S. Bureau of Mines questionnaires.
d. Gas and petroleum figures differ from those published by the Alaska Division of Oil and Gas because of different methods of compiling and reporting. For complete details on fields, wells, etc., see Division of Oil and Gas Annual Report.
e. Includes gemstones, mercury, platinum-group metals, and tin. Figures withheld to avoid disclosing confidential data of individual companies.

Table 2. *Production of major commodities, 1950-1975*

Year	Gold ($ thousands)	Mercury ($ thousands)	Coal ($ thousands)	Oil, Gas ($ thousands)	All production total ($ millions)
1950	10,125	-	3,033	- -	17.9
1951	8,387	-	3,767	-	19.5
1952	8,420	6	5,779	-	26.3
1953	8,882	8	8,452	-	24.3
1954	8,699	277	6,442	-	24.4
1955	8,725	12	5,759	-	25.4
1956	7,325	853	6,374	-	23.4
1957	7,541	1,349	7,296	-	30.2
1958	6,525	774	6,931	-	20.9
1959	6,262	851	6,869	311	20.5
1960	5,887	940	6,318	1,496	21.9
1961	3,998	816	5,868	17,776	34.7
1962	5,784	711	6,409	31,657	54.2
1963	3,485	76	5,910	33,760	67.8
1964	2,045	95	5,008	35,490	66.1
1965	1,479	104	6,095	35,614	83.2
1966	956	101	6,953	50,418	86.3
1967	803	79	7,178	95,455	134.6
1968	835	78	5,034	191,083	221.7
1969	881	100	4,647	227,129	257.6
1970	835	1,260	4,059	279,132	338.2
1971	537	285	5,710	286,977	332.8
1972	910	44	5,696	239,736	286.1
1973	1,875	30	6,230	281,300	328.8
1974	2,560	30	7,325	369,114	433.9
1975	3,349		7,810	377,143	443.6
Total	117,110	8,879	156,952	2,553,591	3,411.0

Table 3. *Physical volume of Alaska mineral production*

Mineral	Units	Quantity
Antimony, 1907-75	Short tons (approx. 53% Sb)	10,380
Coal, 1951-75	Short tons, thousands	25,675
Copper, 1880-1973	Short tons	690,035
Chromite, 1917-57	Long tons (approx. 45% Cr_2O_3)	29,000
Crude petroleum, 1958-75	42-gallon bbls, thousands	686,274a
Gold (total), 1880-1975	Troy ounces	30,050,336
Lead, 1906-73	Short tons	25,028
Mercury, 1902-75	76-lb flasks	29,254
Natural gas, 1948-75	Cubic feet, millions	1,010,173
Sand and gravel, 1958-75	Short tons, thousands	303,036
Silver (total), 1906-75	Troy ounces	19,084,510
Stone, 1921-75	Short tons, thousands	35,635
Tin, 1902-75	Short tons	2,589b
Tungsten, 1916-58	Short-ton units (WO_3)	7,000

a. The only other crude petroleum production recorded was from the Katalla are (about 154,000 barrels of oil, 1901-32).

b. Production data (if any) withheld in 1969-70.

considered at a minimum. Sand, gravel, and stone deposits were omitted.

PRECIOUS METALS

GOLD

The increase in the price of gold stimulated mining in 1974. UV Industries continued to operate their floating dredge on the Hog River.

Near Nome in 1974, UV Industries began reactivating gold dredges 5 and 6 for operation in 1975 and drilled a grid of thaw holes to soften the frozen gold-bearing gravel ahead of the dredges. A work force of about 350 men was anticipated for the 1975 season. (A third dredge is planned for 1976). Offshore from Nome, Asarco continued evaluating a subsea gold placer. They contemplated core drilling through the ice the coming winter (1975), and reportedly are developing offshore gold-dredging equipment for eventual production.

The largest operation on the Seward Peninsula continued to be that of the Tweet Brothers on the Kougarok River. Their placer mining was by both a dredge and a nonfloat operation. Rhinehart Berg reportedly continued work to refloat and reactivate his No. 14 dredge in the Candle area and produced some gold from a nonfloat operation.

Klondike Placers (formerly Standard Mines of Ontario, Canada) spent the summer of 1974 repairing the dam on Hess Creek and rehabilitating the canal to Livengood Creek. Gold production increased on Coal Creek and there was an extensive revival of placer mining in the Circle-Central district. Other producing areas included Manley Hot Springs, Fortymile, Boundary, Wiseman, Ruby, Flat, and Marvel Creek. All known gold production was from placer operation; however, Ptarmigan Exploration continued experimental work on recovering gold from the tailings of the old Nabesna Mine.

In 1975, gold production again increased, with more small operators in essentially the same districts. The significant developments were: 1) by the middle of July, UV Industries had one of their large dredges at Nome in operation. By the end of the season, a second dredge was operational. Their rehabilitation program was delayed because a sea-going barge bringing needed supplies overturned and the cargo was lost. Asarco assembled and operated a pilot plant to further test recovery methods for obtaining gold from the marine sands off the coast of Nome (p. 27).

In the Livengood area, Klondike Placers completed rehabilitation work and began a nonfloat operation for gold recovery. Dan Renshaw, a consulting mining engineer from Anchorage, opened a lode gold mine in the Willow area and produced some gold.

PLATINUM

In 1974 and 1975, Goodnews Bay Mining continued to operate a floating dredge and a sluice box near Platinum. The volume of material treated and the production remained at approximately the same level as it has for the past several years. Minor amounts of platinum were produced by small placer operations.

MAJOR BASE METALS

COPPER

Limited production continued from the McCarthy area. About 40 tons of chalcocite reportedly was stolen from the old Kennecott Mine. The Asarco smelter in Tacoma, Washington, historically the ore buyer serving

Alaska, continued to be unable to accept Alaskan ore because of environmental pollution-control problems.

LEAD

In 1974, a shipment of lead ore was reportedly sent from Glenallen to the East Helena smelter in Montana. The source of the ore is believed to be the Kantishna district. There was no known lead production in 1975.

MINOR BASE METALS

MERCURY

In 1974, Robert Lyman operated a small mine and concentrator at White Mountain, southeast of McGrath. Also, there was a limited amount of production reported from the Aniak area. No production was reported in 1975.

ANTIMONY

In 1974 and 1975, small shipments of hand-sorted antimony ore (stibnite) were reported from the Fairbanks and Kantishna districts. In the summer of 1975, a company in the Fairbanks area started a consolidation of claims and a feasibility study to justify a concentrator.

INDUSTRIAL BARITE

Alaska Barite, a subsidiary of Inlet Oil, continued operation on the underwater open-pit mine near Castle Island, about 12 miles southeast of Petersburg. In 1974, the ship-mounted grinding and bagging plant was moved from Kenai to Castle Island and beached. There, a dense-media concentrating plant to separate barite from waste rock was erected. Both plants were operational by the end of the summer. In both 1974 and 1975, the principal export product continued to be barite rock.

COAL

One of the most notable features of the Usibelli coal operation is their ongoing reclamation and seeding of mined-out property, which has resulted in a popular pasture area for Dall sheep.

Usibelli continued as the principal coal producer, mining about 700,000 tons in both 1974 and 1975. (The annual increase in production is about 5 percent.) No increase in production for use by electric power plant in the interior of Alaska is expected in the near future because Golden Valley Electric Association, the principal producer of electrical power in the Fairbanks area, plans to use gas-turbine generators. Gas turbines are cheaper to install than coal-fired plants, but the fuel cost is higher. (On a Btu basis, according to a GVEA statement made at the Alaska Coal Conference in October 1975, oil for a gas turbine will cost four times as much as coal for the present generators. About half again more Btu's are required to produce a kilowatt with a gas turbine than with a coal-fired plant; thus the fuel cost will be about six times that of coal.)

Dall sheep winter grazing on strip-mined area near Healy. The sheep so readily accepted the new feeding grounds that a state game refuge had to be created.

In both 1974 and 1975, a limited amount of coal was produced for domestic consumption in the Matanuska valley.

As the nation attempts to acquire independence in energy, interest in coal has been revitalized. The following is a summary of Alaska coals prepared by DGGS geologist D.L. McGee.

STATEWIDE COAL

Coals ranging in age from Carboniferous to Tertiary are found in many of the basin areas of Alaska. Although predominantly lignite and subbituminous in rank, the range is complete from lignite to anthracite. Present production is limited almost entirely to the Usibelli production in the Nenana coal field.

NORTHERN COAL FIELDS

The largest coal fields in Alaska are found in the north. Of U.S. coal deposits, the known strippable reserves place this field as second in subbituminous coals and third in bituminous coals.[31] These coals are in the Corwin formation of early Cretaceous age, and have a measured thickness in excess of 15,000 feet.

[31] Conwell, C.N., 1972, Alaskan Coals may Prove a Big Plus in Export Picture, Mining Engineering, October.

Reserves of strippable coal are considered as 5 billion tons of subbituminous and 2 billion tons of bituminous coals. Reserves for this area include 120 billion tons of inferred resources and probably more than 1.5 trillion tons of coal classified as hypothetical.[29]

Mississippian coal samples from the Cape Lisburne area collected in 1975 are low-volatile and high in Btu's (14,000). The bituminous coals, found in a belt along the Brooks Mountain, have a Btu content of 9,300 to 13,450. Subbituminous coals in the area to north have a lower range (8,000 to 12,000 Btu). The moisture content and ash are low, as is the sulfur content (critical in modern power generation from an environmental standpoint), which ranges from 0.2 to 0.7 percent.

NENANA COAL FIELD

The Nenana coal field, located near Healy, produces nearly all the commercially used coal in the state. Present production is about 700,000 tons per year (by Usibelli Coal) and the coal is sold to several military installations and consumers in the Fairbanks area. In addition, electric power is generated at a plant near Healy and transmitted to the Fairbanks area.

Present exploration activity in the Healy area continues with core drilling by AMAX, who at one time during the summer had seven drill rigs operating east of Healy.

RESOURCES

Demonstrated[29] - 2 billion tons
Hypothetical - 8 billion tons

Coal resources that can be stripped—primarily subbituminous steaming coals with a Btu content of 8,500--probably approach 500 million tons. The moisture content is relatively high (17-27 percent) and the ash content is 3 to 13 percent. Sulfur content is low, 0.1 to 0.3 percent.

MATANUSKA FIELD

The Matanuska coal field was mined from 1914 to 1969. The total production from the area has been estimated between 9 and 11 million short tons; the maximum annual production was 286,465 short tons. Conversion from coal to natural gas by the military installations near Anchorage in 1967 was responsible for closing down the operating mines.

Production was from the Tertiary Chickaloon formation. Individual coal beds are usually less than 8 feet thick and most of the beds are less than 5 feet thick.

Although the coals are known in an area of about 400 square miles, mining was restricted to four districts: the Little Susitna, Wishbone Hill, Chickaloon, and Anthracite Ridge. Nearly all the production came from the Wishbone Hill district, an area about 7 miles long extending from the Premier Mine on the west end to the Eska mine on the east.

RECENT ACTIVITY

There has been little exploratory activity in the Matanuska Valley since 1969.

RESOURCES

Demonstrated - 47 million tons
Inferred - 52 million tons
Hypothetical - 149 million tons

Most of the coal is bituminous, with a Btu content of 10,000-13,000; has little moisture (2 to 7 percent) or sulfur (0.2 to 1.0 percent); and has an ash content of 4.4 to 21 percent. This would be a desirable coal for power generation.

SUSITNA COAL FIELD AND VICINITY

This is one of the more important areas and includes the Chuitna, Beluga, and Capps Glacier areas, where extensive coals with favorable stripping ratios occur. The coals are found in the Kenai formation of Tertiary age and are probably correlatible with the Tyonek formation of the Cook Inlet to the southeast, where numerous wells have penetrated the section. The Kenai formation is relatively flat and in many sections, coal beds more than 50 feet thick have less than 120 feet of overburden, providing stripping ratios of less than 3. The low sulfur content (less than 0.2 percent) makes these coals attractive. However, the high water and ash content has impeded their development.

PRESENT EXPLORATION ACTIVITY

One major company continued drilling to delineate reserves with three drill rigs. Others involved in exploratory work, including drilling, were Mobil Oil, Shell Oil, Phillips Petroleum, Portland General Electric, and the U.S. Geological Survey. There has been much interest in these coals by Japanese groups and California utility groups. Also, there has been a high level of land-lease activity.

RESOURCES

Demonstrated - 2.4 billion tons
Inferred - 7.8 billion tons
Hypothetical - 26 billion tons
Stripping coal resources - 700 million to 1 billion tons.

KENAI PENINSULA (HOMER AREA)

The coals in this area are within Kenai sediments. There has been little or no exploration activity within the area recently.

RESOURCES

Demonstrated	- 300 million tons
Stripping coals	- 200,000 short tons with less than 100 feet of overburden.

BERING RIVER COAL FIELD

The Bering River coals grade from lignite on the west to anthracite on the eastern end of the coal field. The associated sediments are Tertiary.

The coals range from 6 to 30 feet thick but demonstrate little lateral continuity. Folding and faulting of the coal-bearing sediments and compression squeezing of the rocks make it very difficult to determine the coal resources of the area.

ACTIVITY

Some exploratory leases are held in the area. The U.S. Geological Survey is presently studying the area. At least one company is interested in doing feasibility studies.

RESOURCES

There may be as much as 3 billion tons of coal in the area.

HERENDEEN BAY AND CHIGNIK COAL FIELDS

The Herendeen Bay and Chignik areas are virtually unknown, with only minor basic field work and no drilling. The known coal beds are relatively thin—the thickest seam is about 5 feet. However, the coal is bituminous with a Btu content of 11,000-12,000 and would be a good coal for power generation.

RESOURCES

The entire area of the Herendeen and Chignik coals could have resources of 2-3 billion tons. This would be considered as hypothetical coal; the extractable coal might be about several million short tons.

YUKON RIVER, EAGLE-CIRCLE, NATION RIVER, AND BROAD PASS

These are all minor districts with combined hypothetical coal resources probably not in excess of 300 million short tons. These coals occur principally in Cretaceous and Tertiary sediments. The size and rank of the coals are unknown.

D.L. McGee

GRAVEL AND BUILDING MATERIALS

Gravel is one of the most important commodities in Alaska, ranking third among the inorganic commodities (behind petroleum and natural gas). Stone, used for riprap and fill, ranked fifth in 1973.

Although final figures are not yet available, gravel will probably rank second in 1974 and 1975—mainly because of pipeline impact.

Gravel is especially important in high-population areas. In Anchorage, for example, housing has been allowed to expand over gravel sources. This has necessitated importing gravel from the Matanuska Valley by rail, thereby raising construction costs.

Gravel is either processed by washing and sizing for use as a concrete aggregate, road-base material, and bitumen paving, or is used unprocessed for fill and base material. Gravel and sand will continue to be important building materials in the Fairbanks and Anchorage areas. Large amounts will also be used in building the proposed capital and for concrete aggregate in building dams for hydroelectric power plants. More gravel source areas must be found to accommodate this growth. Then, an orderly approach to extraction must be established.

Figure 9 is a plot of gravel use versus time. The normal growth curve is based on processed gravel or gravels used in building—both home and commercial.

The discovery of Swanson River oil field in 1957 had relatively little effect on the quantity of gravel extracted. However, when oil was discovered in the Cook Inlet, the amount of gravel used immediately jumped. Roads, pipelines, oil terminals, commercial building sites, and new homes increased the usage rate of gravel fourfold. Later, when oil was discovered at Prudhoe, another enormous demand for gravel followed. However, when the roads and pipeline pads are completed, consumption will probably return to 14-20 million cubic yards per year (unless other major construction is undertaken).

D.L. McGee

INVESTIGATION OF ALASKA'S URANIUM POTENTIAL

Determining the uranium potential of Alaska is a continuing statewide program in which the Division has been involved during the past 2 years. The immediate objective is to provide information that will aid both government agencies and private industry in locating new deposits of uranium urgently needed to fuel nuclear power plants. The investigation of the uranium potential is also a part of the long-range goal to locate and assess all of the mineral and energy resources of Alaska and will be one phase of all geologic investigations of DGGS. Products of uranium investigations will include sample location maps and uranium, thorium, and potassium values for stream sediments, water, and bedrock samples. Results of radiometric surveys made with hand-carried scintillometers will be plotted and related to bedrock geology.

An investigation of Alaska's uranium potential by a compilation of the geologic literature and construction

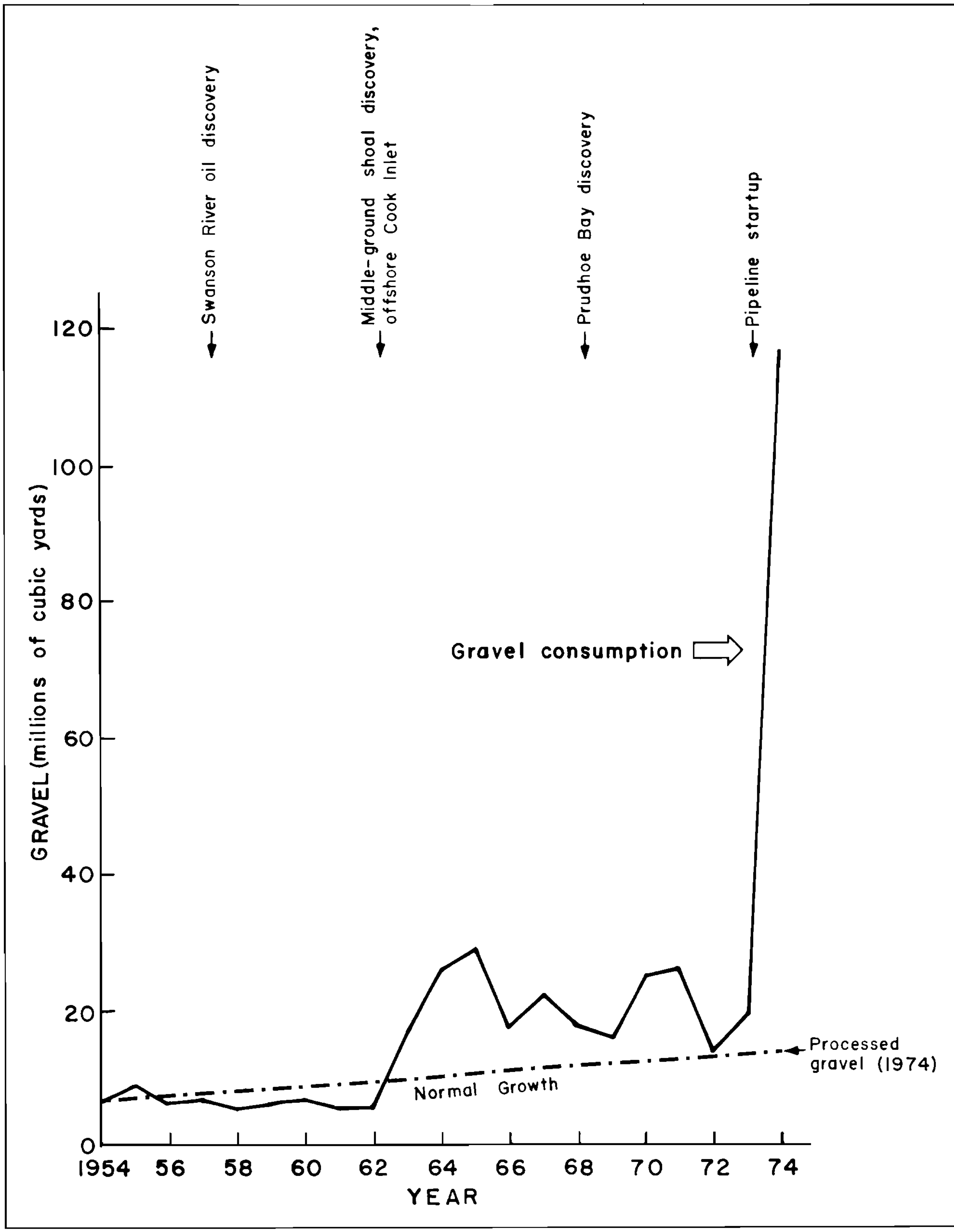

Figure 9. Alaska gravel consumption.

of a 1:1,000,000-scale map of the felsic rocks of the entire state was recently completed for the U.S. Energy Research and Development Administration (ERDA) by R.B. Forbes[18] and G.R. Eakins (p. 13). This was released in late 1975.

During the 1975 field season (under another contract with ERDA), DGGS collected stream-sediment, water, and bedrock samples over wide areas in the eastern Seward Peninsula, in west-central Alaska, and in the Copper River Basin. The highly radioactive felsic intrusions in the Darby Mountains, Selawik Hills, and Zane Hills were of major interest. Eakins, Forbes, and two field assistants were in the field approximately 6 weeks with full-time helicopter support. Results of this work are due to be released in July.

The areas sampled were a part of the area covered by an aerial radiometric survey for ERDA by Texas Instruments (TI). Fifty-four flight lines were flown in the Seward-Selawik region, covering 7,630 line miles, and 17 flight lines were flown in the Copper River region (1,950 line miles). Spacing was at 6.25 miles, with tie lines every 25 miles. Results of the aerial survey were released in late 1974. TI reported 33 "preferred" anomalies in the Seward-Selawik region and four in the northern part of the Copper River Basin. For the 1975 aerial surveys, TI, which was paid about $1 million by ERDA for their services, used the most sophisticated radiometric equipment available. The program will continue for the next 4 years, when complete coverage of the entire state will be attained. DGGS assisted Texas Instruments in planning the program.

Analyses of the stream-sediment and bedrock samples are being done by the Division laboratory, which can determine uranium, thorium, and potassium on large numbers of samples (p. 23). The water samples are being analyzed by the ERDA laboratory in Los Almos, NM.

Uranium investigation next summer will be conducted along the north flank of the Alaska Range in conjunction with the Central Alaska Range Highlands programs of W.G. Gilbert and T.K. Bundtzen. Base camps and helicopter time will be shared by the two projects. The Tertiary coal-bearing beds on the north flank will be sampled for possible sedimentary-type uranium deposits, granitic areas in the Alaska Range will be examined for possible vein-type uranium deposits, and metal mines in the region which could have uranium associated with their ores will be checked. Since coal and uranium prospects are frequently present within the same formation, a coal assessment may be undertaken with the uranium program for inclusion in the Central Alaska Highlands program; 4 to 6 weeks are planned for the uranium-coal program.

The one commercial uranium deposit found to date in Alaska is the Ross-Adams mine at Bokan Mountain, 40 miles southwest of Ketchikan on Prince of Wales Island. The deposit, discovered by two Ketchikan prospectors in 1955, was worked intermittently by various operators until finally depleted by Newmont Mining Corporation in 1971.

Although small by most standards, the deposit was high grade, easily accessible, and close to water transportation. During the early phase of operation, 60,000 tons of ore averaging nearly 1 percent U_3O_8 was produced; during the later phase Newmont produced another 55,000 tons of ore that averaged about 1.5 percent U_3O_8.

The ore at Bokan Mountain seems to be an unusual occurrence; the host rock is a small stock of peralkaline granite that was intruded on an older pluton of diorite. The ore minerals, uranothorite and uranoanthorianite, occur as grain coatings and fracture fillings in a microbrecciated zone within the peralkaline granite.

Exploration for uranium in Alaska is increasing steadily. The state is of special interest because it offers a vast area still essentially untested for uranium. ERDA's National Uranium Resource Evaluation program calls for completion of a hydrochemical survey and the aerial radiometric survey of the entire state by 1980. Total cost of the aerial survey is expected to be over $4.5 million. The water sampling program will be handled largely by their Los Almos laboratory.

Several private companies were actively exploring for uranium during the last two seasons—principally

Coarse gold from Glenn Creek, Kantishna mining district - two 1-ounce nuggets in this cleanup.

in the Seward Peninsula—Selawik region, the Healy coal district, the Kokrines Hills, and Prince of Wales Island. Those who reportedly conducted geochemical or radiometric surveys or drilling programs include Wyoming Minerals (Westinghouse); Watts, Griffis, and McQuat; Union Carbide, the German firms Uranerz and Urangellschaft; and Standard Metals.

G. R. Eakins

PETROLEUM AND NATURAL GAS

SIGNIFICANT PETROLEUM DEVELOPMENTS IN ALASKA - 1974 AND 1975

Activity related to petroleum has been increasing greatly in the past 2 years, stimulated in part by the construction of the Trans-Alaska Pipeline and in part by the increased need for energy resources in the nation. Pipeline construction reached a peak of activity in 1975, and was about half complete at the end of the construction season. There have been difficulties in related construction at the Valdez terminal for the pipeline, and the necessary delivery of production equipment at the Prudhoe Bay field was set back slightly when pack ice held up a barge convoy along the northern coast.

The energy crisis facing the nation led to the proposal of a leasing plan for Alaska's outer continental shelf by the Federal Government, and a sale schedule was released in November, 1974. The first sale was to be in the Gulf of Alaska in December 1975, for 1.8 million acres, but this sale was postponed to January 1976. The State has proposed a lease sale in state-owned offshore lands in the Beaufort Sea for sometime in 1976.

In preparation for the proposed Gulf of Alaska lease sale, the Federal Government permitted a stratigraphic test to be drilled in the gulf by a group of 26

Last vestiges of Katalla oil field near Yakataga, Gulf of Alaska, 1975 (well 7). This field, with 30-odd wells, produced 150,000 barrels of oil from 1902-30. Refinery destroyed by fire in 1933.

companies. The test well, COST 1 (Continental Offshore Stratigraphic Test), was started in the late summer of 1975 with a target depth of 16,500 feet, but was plugged and abandoned in October, after reaching a depth of 5,500 feet.

Exploration in Alaska has led to a number of significant discoveries in the last year. On the North Slope, ARCO announced that their East Bay State 1 well had found hydrocarbons in the Lisburne Group carbonates. The company subsequently announced that both the Lisburne Group and the Kuparuk River Sandstone contain "significant quantities" of hydrocarbons, a fact that greatly enhances the chances for more discoveries along the northern coast of the basin and offshore in the Beaufort Sea. Mobil Oil's Gwydyr Bay 1 well was also announced as an official discovery in sandstones of the Sadlerochit Formation. In the Cook Inlet basin, Cities Service made a gas discovery in the Lewis River 1 well.

The Native corporations stimulated petroleum exploration on lands withdrawn for selection under the Native Claims Act by entering into contracts with various oil companies for exploration work on those lands. These agreements led to drilling activity in some previously untouched basins and greatly increased the level of seismic exploration in a number of areas. Two exploratory wells were drilled in the Selawik basin by SOCAL under an agreement with the Northern Alaska Native Association. The wells were later plugged and abandoned. Louisiana Land and Exploration Co. entered into an agreement with Doyon Ltd. to drill at least four tests in the Kandik basin, starting late in 1975.

The southern part of the Cook Inlet basin was the subject of both exploration interest and legal contention. A long contest between the State and the Federal Government over ownership of the offshore part of southern Cook Inlet was finally resolved by the U.S. Supreme Court in June 1975, with the acreage being awarded to the Federal Government. A lease sale on this acreage is now scheduled by the Government for 1976. A lease sale on State acreage in Kachemak Bay in December of 1973 led to a complex legal battle over a proposed test well in the bay by Shell Oil. Shell was issued a permit to drill, but a law suit by local residents was filed, seeking to invalidate the lease sale and stop the drilling. At the current time, Shell is waiting for the suit to be settled by the Alaska Supreme Court.

A number of recent political and legal actions will have an important effect on petroleum activities in the state. In 1975, the state legislature passed a controversial tax on in-place reserves of oil and gas. The tax has not been implemented as yet. A massive trespass suit was filed in 1975 against a number of oil companies, the pipeline company, numerous other firms, and the State of Alaska charging trespass violations and damages on

Native lands of the North Slope prior to 1971. The suit, still pending in the courts, is the subject of proposed legislative action by the U.S. Congress. In late 1975, a complex plan was proposed for trading land in the south-central part of the state among the Federal Government, the State, and the Native corporations. The ownership of potential oil and gas lands within the Cook Inlet basin would be affected if this plan is adopted.

Another important decision yet to come is the selection of a route for the gas pipeline to transport gas from the North Slope to markets in the U.S. One plan proposes to transport the gas via a pipeline through Canada to the midwest, and the other plan calls for a trans-Alaska gas line, with liquefaction and transportation to the west coast by liquefied-natural-gas tankers. The selection of a gas-line route will have an important effect on the level of industrial development and construction activity in Alaska in the near future.

G.H. Pessel, D.L. McGee

STATISTICAL SUMMARY

DEVELOPMENT IN ALASKA IN 1974

Eleven exploratory wells were drilled in Alaska in 1974.[32] There were no new discoveries. Four successful exploratory completions, all in the Arctic North Slope region, were classified as extensions of existing field pools. Twenty development wells were successfully completed, one on a new gas zone in the Kenai gas field.

Geological and geophysical field activity by the petroleum and natural-gas industry was up 102 percent to 168.3 crew-months, with all basins except the Yukon-Kandik sharing the increase. Another 41 crew-months of geological and geophysical field work were undertaken by the U.S. Geological Survey—part of which was in cooperation with DGGS.

Other exploration included increased activity on Naval Petroleum Reserve 4 and consideration by industry of four tests as part of the COST program.

Federal acreage under lease decreased 11.4 percent (to 3,925,000 acres), whereas comparable state acreage increased 18.2 percent (to 4,938,000 acres).

Production for 1974 was 72,244,000 barrels of oil, 793,000 barrels of liquid natural gas, and 126,034 million cubic feet of dry gas.

DEVELOPMENT IN ALASKA THROUGH OCTOBER 1, 1975

Nineteen wildcat tests were drilled in 1975—seven in the Cook Inlet basin, one in the Selawik basin, and 11 on the North Slope. Twenty-six development tests were drilled; 10 of these were reported as oil wells. Oil production through August of 1975 was 47,540,000 barrels.

Petroleum and natural-gas exploration activities will increase substantially in the future, assuming the Federal Government follows its proposed Outer Continental Shelf leasing schedule (fig. 10). Unresolved conflicts between federal and state interests may alter the schedule.

W.M. Lyle

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[32] Am. Assoc. Petroleum Geologists Bull., v. 99/8, 1975; and State of Alaska, Dept. of Natural Resources, Div. Oil and Gas Statistical report for 1974.

SALE AREA	No.	1974 J	A	S	O	N	D	1975 J	F	M	A	M	J	J	A	S	O	N	D
SOUTH TEXAS	37		DES	PH		BSI FES		N	Sale					S	A	L	E		H
CENTRAL GULF	38	ND			T		DES	PH		FES	N	Sale							S
CENTRAL GULF	38A	ND			T		DES	PH		FES	N			Sale					
SOUTHERN CALIF.	35		T						DES			PH	BSI		FES	N	Sale		
COOK INLET	1/	F	E	D	E	R	A	L		-		S	T	A	T	E		S	A
GULF OF ALASKA	39	BSI				C	ND			T			DES		PH		FES	N	Sale
GULF OF MEXICO (GENERAL)	41						C	ND		T				DES		PH			FES
MID-ATLANTIC	40									C			BSI ND		T		DES		PH
NORTH ATLANTIC	42												C		ND	BSI	T		
GULF OF MEXICO (DRAINAGE)	44																		T
SOUTH ATLANTIC	43													C			BSI ND		
GULF OF ALASKA (INCLUDING KODIAK)	46													BSI			C		ND
BERING SEA (ST. GEORGE)	45						C	ND				BSI		T					
GULF OF MEXICO (DEEP)	47																		
SO CALIFORNIA	48																		
MID-ATLANTIC	49																	BSI	
BEAUFORT SEA	50											BSI BSI							
OUTER BRISTOL BASIN	51											BSI							
NORTH ATLANTIC	52															BSI			
CALIFORNIA GENERAL INCL. WASH. & OREGON	53																		
SOUTH ATLANTIC (BLAKE PLATEAU)	54																		
BERING SEA (NORTON BASIN)	55																		
GULF OF ALASKA – ALEUTIAN SHELF	56													BSI					
CHUKCHI SEA HOPE BASIN	57																		

SALE AREA	No.	1976 J	F	M	A	M	J	J	A	S	O	N	D
SOUTH TEXAS	37	E	L	D		I	N		F	E	B	R	U
CENTRAL GULF	38	A	L	E		H	E	L	D		I	N	
CENTRAL GULF	38A												
SOUTHERN CALIF.	35												
COOK INLET	1/	L	F		-		D	A	T	E		U	N
GULF OF ALASKA	39												
GULF OF MEXICO (GENERAL)	41	N	Sale										
MID-ATLANTIC	40			FES	N	Sale							
NORTH ATLANTIC	42	DES		PH			FES	N	Sale				
GULF OF MEXICO (DRAINAGE)	44			DES		PH			FES	N	Sale		
SOUTH ATLANTIC	43	T			DES		PH			FES	N	Sale	
GULF OF ALASKA (INCLUDING KODIAK)	46		T			DES		PH			FES	N	Sale
BERING SEA (ST. GEORGE)	45								DES		PH		
GULF OF MEXICO (DEEP)	47	C		ND			T			DES		PH	
SO CALIFORNIA	48			C		ND			T			DES	
MID-ATLANTIC	49					C		ND			T		
BEAUFORT SEA	50							C		ND			T
OUTER BRISTOL BASIN	51									C		ND	T
NORTH ATLANTIC	52											C	
CALIFORNIA GENERAL INCL. WASH. & OREGON	53								BSI				
SOUTH ATLANTIC (BLAKE PLATEAU)	54	BSI											
BERING SEA (NORTON BASIN)	55			BSI									
GULF OF ALASKA – ALEUTIAN SHELF	56												
CHUKCHI SEA HOPE BASIN	57							BSI					

SALE AREA	No.	1977 J	F	M	A	M	J	J	A	S	O	N	D
SOUTH TEXAS	37	A	R	Y		1	9	7	5				
CENTRAL GULF	38	M	A	Y		1	9	7	5				
COOK INLET	1/	C	E	R	T	A	I	N					
BERING SEA (ST. GEORGE)	45	FES	N	Sale									
GULF OF MEXICO (DEEP)	47		FES	N	Sale								
SO CALIFORNIA	48	PH			FES	N	Sale						
MID-ATLANTIC	49	DES		PH			FES	N	Sale				
BEAUFORT SEA	50			DES		PH			FES	N	Sale		
OUTER BRISTOL BASIN	51					DES		PH			FES	N	Sale
NORTH ATLANTIC	52	ND			T			DES		PH			FES
CALIFORNIA GENERAL INCL. WASH. & OREGON	53	C		ND			T			DES		PH	
SOUTH ATLANTIC (BLAKE PLATEAU)	54			C		ND			T			DES	
BERING SEA (NORTON BASIN)	55					C		ND			T		
GULF OF ALASKA – ALEUTIAN SHELF	56							C		ND			T
CHUKCHI SEA HOPE BASIN	57									C		ND	

SALE AREA	No.	1978 J	F	M	A	M	J	J	A	S	O	N	D
NORTH ATLANTIC	52	N	Sale										
CALIFORNIA GENERAL INCL. WASH. & OREGON	53		FES	N	Sale								
SOUTH ATLANTIC (BLAKE PLATEAU)	54	PH			FES	N	Sale						
BERING SEA (NORTON BASIN)	55	DES		PH			FES	N	Sale				
GULF OF ALASKA – ALEUTIAN SHELF	56			DES		PH			FES	N	Sale		
CHUKCHI SEA HOPE BASIN	57		T			DES		PH			FES	N	Sale

BSI Baseline Studies Initiated
C Call for Nominations
ND Nominations Due
T Announcement of Tract
DES Draft Environmental Statement
PH Public Hearing
FES Final Environmental Statement
N Notice of Sale
1/ State May Conduct Sale

Baseline studies scheduled are contingent upon scientific personnel and equipment being available to perform the studies.
Sales are contigent upon technology being available for exploration and development. A decision whether to hold any of the lease sales listed will not be made until completion of all necessary studies of the environmental impact and the holding of public hearings, as a result of the environmental, technical, and economic studies employed in the decision – making process, a decision, may, in fact, be made not to hold any sale on this schedule.

Director,
Bureau of Land Management

FIGURE 10. Outer Continental Shelf leasing schedule – June 1975.

Red fox inspecting camp cuisine, Arctic air strip, Brooks Range.

PUBLICATIONS[33]

DGGS publishes annual and biennial reports, information circulars, miscellaneous papers, geologic reports, open-file reports, special reports, laboratory notes, and bibliographies. The DGGS staff also presents papers at national conferences and contributes to national publications (p. 51).

ANNUAL AND BIENNIAL REPORTS, 1912-1973

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