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John W. Katz—Commissioner
Geoffrey Haynes—Deputy Commissioner

Ross G. Schaff—State Geologist

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*Mining-information office +Publications office

DGGS wraps up FY-81

Some of the projects DGGS worked on during fiscal year 1981, which ended this past June 30, are described below. Many of them continue into this fiscal year.

Oil and Gas

Tract Evaluation

The tract evaluation group completed a geological and geophysical analysis of the state acreage being offered in Oil and Gas Lease Sale 32, Cook Inlet south Kenai River. The sale included 202,884 acres, offshore and onshore, which have been divided into 78 tracts.

Petroleum geophysicists James Hansen and Sonja Weum interpreted seismic data and prepared seismic time maps at a scale of 1 in. = 8,000 ft for three horizons: basement (pre-Tertiary), top of Hemlock Formation, and top of Tyonek Formation. Cook Inlet and Kenai Peninsula wells were examined by William Lyle and Richard Kornbrath to construct structure and isopach maps at a scale of 1:250,000.

On June 16, the recommendations of the group were presented to Commissioner LeResche and his successor, John Katz, to select a bidding method. (The

bidding method will be royalty bidding, with a minimum bid of 20 percent and a fixed cash bonus of \$10 per acre.)

Oil and Gas Lease Sale 33 was held May 13. Of the 202 tracts offered, 103 received bids. The highest royalty bid was 64.10080 percent, offered by Chevron, AGEA, and Amarex. The total of the accepted fixed-cash bonus bids for the sale was \$4,300,000.

The next sale on the schedule is the Lower Cook Inlet Sale 35, which will be held next January. (D.L. McGee)

The following is a synopsis of the projects.

Minchumina Project

A basin analysis study of the Minchumina area consisted of the coordination of both geological and geophysical data collection. Geophysicists collected gravity and magnetic data along six different profiles throughout the area.

West-central Alaska

Field studies made in the McGrath, Medfra, and Lime Hills Quadrangles in June established gravity profiles along the South Fork of the Kuskowim River, Windy Fork, and Big River. A shorter profile was made on the North Fork of

the Kuskokwim River; an east-west profile was conducted to tie the north-south river profiles. The lithologies within the Paleozoic, Mesozoic, and Tertiary sedimentary sequences were studied for reservoir and source-rock potential and to establish general facies and structural trends. (M.W. Henning)

Yukon-Kuskokwim Project

A report prepared on the oil and gas potential of the Yukon-Kuskokwim area was prepared for any future lease sale or land trade.

Lower Cook Inlet Project

This is a wrap-up of last year's work on the lower Cook Inlet. Data generated supplement existing COST well data.

North Slope Project

Work continues on preparing for the Prudhoe Uplands and second Beaufort Lease Sale in 1982. Data are being analyzed. (W.M. Lyle)

1981 Water Resources

In addition to the basic projects of statewide surface-water and ground-water monitoring, the DGGGS Water Resources section worked on the logging of water-well data statewide; ground-water data compilation of the Matanuska Valley; a navigability defense of submerged lands; and agricultural baseline studies.

The Statewide Surface-water Monitoring project gathers data from streams and lakes, including regular discharge measurements, water-quality sampling, erosion and flooding evaluations, and reconnaissance surveys. Much of the information collected is published through a cooperative program with USGS Water Resources Division.

The Statewide Ground-water Monitoring project supports water-level recorders, well-level tapping surveys, lake-level recorders and observations, and statewide water-quality sampling. Until recently, most ground-water monitoring has been done in urban areas; in FY-81, the project continued to expand to smaller population centers such as the Bristol Bay area.

In the Water-well Log project, data from well drillers are gathered and entered into the USGS WATSTORE com-

puter system. Nearly 1,000 well logs were obtained and entered last year.

In the Ground-water Modeling project, ground-water data were analyzed for the Anchorage, Matanuska Valley (DGGGS team), and the Badger Road area near Fairbanks (USGS). The USGS will publish results describing ground-water levels, potential well yields, and aquifer details during the coming year.

In the Navigability Defense of Submerged Lands project, the physical characteristics of certain streams are studied to provide data to the DNR Division of Research and Development, which represents the state in its confrontation with the federal government over which streams are navigable. (The land beneath those streams deemed navigable belongs to the state.) Carefully derived physical characteristics for about 70 streams in the lower Yukon and Kuskokwim basins were presented to DRD; two lakes were also analyzed and are being used as test cases.

The Agricultural Lands Baseline studies result from a special request by the Agricultural Action Council. In FY-81, DGGGS erected weather stations in the agricultural land areas of Pt. MacKenzie and Delta to analyze meteorological data for each area. (Another near Nenana was delayed but will be installed next month.) Data from the installations will be used by Soil Conservation Service to develop conservation plans for each area. (W.E. Long)

Resource Investigations

Coal Investigations

This is a long-range project that will ultimately produce a set of coal atlases for the principal coal fields in Alaska. Each atlas will contain several maps showing the extent of known coal beds, estimated reserves, coal quality, bed thicknesses, and depths. This will require the compilation of all available data on each area, geologic mapping in the field, sampling of coal beds, and analytical work on the coal and sediment samples; where the situation warrants and funds are available, trenching and drilling will be conducted. Field operations will require helicopter support. In FY-81 a study of the coal field in the Susitna Basin was started.

Work during the past year has pro-

duced preliminary compilations of the bedrock and surficial geology, structure, and gravity surveys on a scale of 1:250,000. Also, an extensive bibliography on the geology and coal deposits of this region was assembled.

The project will continue during FY-82 under the direction of Roy Merritt, who will conduct field and laboratory studies of the stratigraphy, petrography, and environments of deposition. (G.R. Eakins)

Fairbanks Project

In 1980, the Fairbanks North Star Borough and the state Legislature funded DGGGS and the UA Mineral Industry Research Lab to jointly study the mining districts near the borough and to generate information that might enhance the mineral industry in the region. Efforts have been directed at producing a regional geologic map, a regional geochemical map, a geochemical landscape map, and a detailed map of selected surface and underground workings. Two UA graduate students are studying the structural geology and intrusive rocks of the district as their thesis topics. Field work will continue through October; data compilation will occupy most of the winter. (T.E. Smith)

Assay Lab

The DGGGS Geochemistry section finished the year with slightly over 20,000 analyses completed. This is a substantial increase over previous years and reflects a larger number of requests from the public, the activities of the joint UA-DGGGS Fairbanks project and other ongoing DGGGS studies.

In FY-82, the Geochemistry section will provide analytical data to support the DGGGS State-wide Resource Assessment Program. Additionally, the lab will begin work in plasma spectroscopy and geochemical-data modeling. (M.A. Wiltse)

Geologic Hazards

North Slope Study

S.E. Rawlinson and S.B. Hardy concentrated on the Beechey Point Quadrangle, identifying by photointerpretation 45 map units in a 3-mi-wide coastal strip from Point Oliktok 25 mi east to Prudhoe Bay, including the off-

shore islands and an 8-mi-wide inland strip from Prudhoe Bay west about 13 mi to just south of Milne Point. They studied rates of coastal erosion and flood hazards of all deltas from the Colville River east to the Canning River. Their schedule calls for completion of 12 inch-to-the-mile maps in the next 2 yr.

Peat Studies

Rawlinson and Hardy completed photomapping of peat deposits in the Susitna Valley from Talkeetna south to Point MacKenzie, both east and west of the Susitna River, and near Dillingham. This study, funded by the U.S. Dept. of Energy through Alaska's Division of Energy and Power Development, has in part been contracted to Northern Technical Services (Nortec) of Anchorage, which will conduct a field study and sampling program in the Dillingham and Willow areas in cooperation with the USGS (Cornelia Cameron).

Snow Avalanche Hazards

G.D. March and L.G. Robertson completed two sets of open-file maps showing locations of snow avalanche paths (AOF 128) and classes of mountain slopes (AOF 129) in the vicinity of the Seward Highway. Preliminary work on an atlas of snow avalanches along the highway is progressing on schedule and a final product is expected by next fall.

Coastal Projects

March completed several hundred consistency reviews during FY-81 along with numerous reviews of district programs. Several requests for district assistance were answered.

J.T. Kline made a photointerpretive study of a coastal strip from Nome west about 50 mi to Cape Douglas.

Nenana Agricultural Project

Rawlinson, March, and R.D. Reger spent about 4 months preparing photointerpretive maps of the Fairbanks B-5, B-6, C-5, and C-6 and the Kantishna River B-1 and C-1 Quadrangles to show the distribution and character of surficial geology, geologic (construction) materials, permafrost, and wetlands units. These unpublished maps, requested in support of development in the Nenana agricultural area, will be

field verified during FY-82 or FY-83 and subsequently published in color. Reger is supervising a small pilot contract with the University of Alaska Geophysical Institute to assess seismic activity in the Nenana agricultural area.

Skagway Study

March and Robertson began preliminary work on mapping the surficial geology, construction materials, and natural hazards in the Skagway B-1, B-2, C-1, and C-2 Quadrangles. The work is scheduled for completion in 2 yr.

General Geologic Hazards

Special Report 15, a study of the geologic hazards in the Fairbanks area, by T.L. Pêwê, came closer to fruition. It will be published this fall. The first six of a series of DGGs geologic reports consisting of orthophoto-based color maps showing geology and geologic materials in the Wasilla-Palmer area were released earlier this summer (p. 8). Dick Reger and Cheri Daniels spent 3 years preparing these maps. Reger will complete several more 1:25,000-scale maps this year to complete the series. With T.K. Bundtzen, J.T. Kline coauthored a detailed map of the Grant gold lode mine on Ester Dome, and is writing an information circular on Alaska's natural hazards. (R.D. Reger)

Earthquake Hazards Reduction Program

Geotechnical studies and geologic mapping in the Anchorage area were done under cooperative DGGs-USGS agreements. A detailed engineering geologic study of the Government Hill area was concluded and a report and maps are in press. A data-storage system of subsurface geological and geotechnical information on Anchorage was instituted with bore-hole and trench data obtained from numerous agencies and private firms. South Anchorage is being mapped at a scale of 1:10,000 with these data. All existing slope-inclinometer casings installed since the 1964 earthquake were surveyed; a geologic report is in progress. The dynamic properties of the Bootlegger Cove Formation are being studied by deep coring, undisturbed sampling, static laboratory testing, and dynamic testing. (R.G. Updike)

Governor names John W. Katz new DNR Commissioner

On July 1, John W. Katz, 37, assumed the Commissioner's seat, replacing Robert E. LeResche, who resigned. Katz, a lawyer who won high marks for helping coordinate the Alaska Lands Bill through Congress, has a broad background in resources issues, particularly dealing with land.

Katz, who headed the Governor's Washington, D.C. office, will oversee a multitude of resource issues--oil, gas, coal, and an expanding mining industry. "I couldn't be more pleased or enthused by Katz' decision to take on the terrific pressures and responsibilities of this demanding job," said Gov. Jay Hammond.

Pricing and use of the state's royalty oil will be one Katz' top priorities. Also on his list are an assessing of the state's position on the Alaska natural-gas pipeline, implementing state land-disposal laws, and continuing his present work protecting state interests under the Alaska Lands Act.

In a July 1 meeting with the heads of his new department, Katz touched on a number of issues and personal philosophies, particularly working hand-in-hand with the public. He stated, "The Department of Natural Resources is the steward of the public's land" and that DNR's principal duties were "land management and public service."

Katz said he wants public input in his decision-making process. "Very few natural-resource problems are insolvable," he said. "I am going to work together with the public, the feds, and the department to find solutions," he said, adding, "I want to be held personally accountable by the public for the efforts of the DNR."

Another of his prime concerns is the state's policy toward hard-rock mining. He said that the attorney general's opinion of the Statehood Act mandating scrapping the state's present mining claim system and requiring leasing instead is "certainly a competent and professional handling of the subject," but added that interpretation of the law is a "very close question." Enforcing the opinion in its current form could have "far-reaching impacts" that would require major policy changes

by the state, the new commissioner said (p. 5).

Katz has been heavily involved in Alaska's natural resources for the past decade, having worked as counsel for the Joint Federal-State Land Use Commission from 1974-79. Before that, he was a legislative aide to Sen. Ted Stevens and Rep. Howard Pollock.

The new DNR head is a 1969 graduate of the University of California at Berkeley law school.



Geologic Materials Center opens

DGGS will enter into a cooperative agreement with the U.S. Geological Survey to provide a Geologic Materials Center. This center, as well as the Water Section of the division, now occupies the abandoned fish hatchery above Lower Fire Lake on Fish Hatchery Road out of Eagle River.

"We have about 6,000 square feet of space at the center," commented State Geologist Ross Schaff, "in which to store core samples drilled by USGS. This will allow access to both the public and industry."

According to Schaff, the new center will make it possible for interested persons, contractors, or engineers to see ground samples from an area being studied. Schaff expects that, eventually, core samples from oil and gas drilling will also be available at the center. The center also houses rocks, fossils, and other geologic materials.



Number of new claims increases slightly

There were 4,551 new claims recorded at the state's recording offices during the past 3 months. This is somewhat higher than the 4,153 that arrived at DGGS the previous quarter but less than the 5,795 claims that were processed in the 1980 summer quarter.

Most of the activity occurred in the Fairbanks district, where 1,623 claims were filed. At the Anchorage recorder's office (now moved from the old Courthouse to the Australaska Bldg, 1004 W. 4th) 1,140 new claims were processed.

DGGS's Mildred Brown noted the flurry of activity from the Seward

district. "The 292 new claims from the Seward recorder is about 290 more than we usually get," she said.

	<u>April</u>	<u>May</u>	<u>June</u>
Fairbanks	345	609	669
Barrow	1	0	0
Manley H. Spr.	15	19	49
Nulato	7	5	0
Mt. McKinley	3	59	72
Nenana	56	48	17
Rampart	15	9	23
Ft. Gibbon	78	20	36
Kotzebue	0	0	1
Talkeetna	188	83	119
Palmer	25	18	66
Nome	0	1	73
Seward	60	123	109
Juneau	101	72	0
Haines	8	0	0
Ketchikan	4	0	0
Sitka	10	0	5
Anchorage	200	940	0
Cordova	24	13	0
Glennallen	0	0	19
Kuskokwim	0	85	0
Kodiak	0	2	19
	<u>1,140</u>	<u>2,106</u>	<u>1,305</u>



They said it...

"If you'd like to become a miner, the requirements are relatively straightforward. You literally drive a couple of sticks into the ground where you want to stake your claim and then record the claim within ten days at the Mining Recorder's Office in Dawson. With a year, you must prove to the authorities that you've taken at least \$200 worth of ore out of the ground or you'll have to forfeit the claim and pull up stakes.

"And even if you don't find much gold, think of the cocktail-party-conversation potential."--Playboy, 6/81.

"We had a chance to explore a very geologically interesting area in deep ocean. We found evidence of geological processes proceeding at heretofore unimagined rates--decades rather than millenia."--Geophysicist James Kosalos, member of 1980 search team looking for the Titanic, sunk on April 15, 1912.

**Gerald FitzGerald, noted Alaskan mapper,
1898-1981**

The following obituary was written by Marvin D. Mangus, Anchorage geologist and long-time friend of the deceased.—Ed. note.

Gerald FitzGerald, noted topographic engineer, died in Rockville, Maryland in February 1981, at the age of 83. He was born in Burns, Oregon and was educated in private and public schools in Oregon and Washington. In 1917 he joined the U.S. Geological Survey and worked on wide variety of surveying and mapping assignments in the western United States, the West Indies, and Alaska. He was Chief Topographic Engineer on his retirement in 1957.

Fitz, as he was called, is probably best known for his Alaskan work, which began in 1922. He excelled and specialized in reconnaissance mapping, and in 1938 succeeded Harvey R. Sargent as head of topographic surveys in Alaska. Fitz seemed most proud of and eager to talk of his arduous arctic trips into the remote National Petroleum Reserve 4 and the central and western Brooks Range (1924-26). During his career, Fitz mapped for eminent Alaskan geologists J.B. Mertie, Jr., P.S. Smith, F. Moffit, and S.R. Capps. In 1937 he finished surveying the 'Yukon-Porcupine triangle' and published a bulletin which was more or less a continuation of the work he and Mertie started in 1923. Besides having many friends, he had just as many interesting tales about Alaska and Alaskans.

In 1960 Fitz was awarded an honorary doctors degree from the University of Alaska. A number of years later he presented the university with his private collection of papers and journals on early Alaskan exploration. He also gave the university a fine collection of Alaskan landscape paintings executed by E.P. Ziegler and by his brothers, Maurice and Edmond J. FitzGerald.

In 1942 Fitz was commissioned a colonel in the U.S. Army Air Force and assigned to the Aeronautical Chart Service. He was a member of the Cosmos Club, Explorers Club, American Geophysical Union, Washington Society of Engineers; was a Fellow of the American Association for the Advancement of

Science; and was Governor of the Arctic Institute of North America. He was also past president and an Honorary Member of the American Photogrammetry Society and was presented the first Photogrammetry Award in 1944. In 1946 Fitz was given the Legion of Merit for his work in World War II and was awarded the U.S. Department of the Interior Gold Medal Award for distinguished service in 1949.

I was fortunate to have known Mr. FitzGerald and always enjoyed our visits and conversations. Needless to say, any geologist who has done field work in Alaska has seen his name on maps and in publications many times. We are indebted to Mr. FitzGerald's foresight on his last big project, which was administrating the now current 1:250,000-scale topo sheets of Alaska.

Nome nightlife boomed in 1940, too—

Here is another memo unearthed from the files of the old Territorial Department of Mines by Jeff Kline, DGGs's resident geologist - 'archaeologist.' In this one, written in the halcyon prewar summer of 1940, assayer Aben Schallit is bringing R.L. Stewart, chief clerk of the Juneau office, up to date on events in Nome. (Parenthetical additions are ours. We don't know who 'Med and Edna' are.)—Ed. note.

July 3, 1940

Dear R.L.—

B.D. (Stewart, TDM Commissioner) arrived Wednesday and left yesterday. I worked like a good-fellow and got my work up to date, figuring he might want to go out in the country some place with me. The weather was bad and we stayed in town, me with practically nothing to do. Now that he is gone the work is starting to pile up again. Such is life in the far north!

Med and Edna won't be able to move for another month. They are getting fed up with cabaret life via a window above the dance hall. It's a cinch they won't sleep with the next few days celebration. Edna is getting so that she likes the town better than she did the first night, and Med is certainly keeping busy on his job.

Betty and I got a shack we are fixing up in our spare time. At the

rate we are going it will be finished by next June. By that time the ground will have heaved and the house shifted so that we can start over again.

Mertie (J.B., Jr., USGS geologist) was telling me that the USGS were planning to drop the 'na' at the end of the names for the rivers, as 'na' meant 'river' in Indian, as Nenana; they changed their minds when the Oshitna river was discussed.

A. B. S.

'Clearwater Mountains' report, 5 AOFs released

When it rains, it pours. DGGGS published a host of documentation this past quarter, including the long-awaited 'Clearwater Mountains' geologic report and a set of colored maps of the geology and geologic materials of the Matanuska-Susitna Valley (see following article). In addition, DGGGS printed five open-file reports and revised one large information circular.

The first document, Geologic Report 60, 'Geology of the Clearwater Mountains, south-central Alaska,' is a 72-page booklet by Thomas E. Smith, of the DGGGS staff. The report is a description of the geologic structure, stratigraphy, and petrology of a zonal metamorphic terrane near the Denali Highway. Prepared in cooperation with the USGS, the report also has a section on the economic geology of the area by DGGGS's Thomas K. Bundtzen.

State Geologist Ross G. Schaff said, "This is clearly the most definitive publication the State Survey has ever made. Dr. Smith's geologic mapping effort provides a type section across the major lithologic belts that extend for many miles through both the Clearwater and Talkeetna Mountains." Schaff added, "The knowledge of the area gained helped immeasurably in filling the void in areas of the state that have not been geologically mapped. Dr. Smith's 9 months of field work, spread over three summers, were well worth the funds expended."

Geologic Report 60 costs \$7.50.

Other documentation printed includes the following open-file reports.

.AOF-121, 'Preliminary geologic map of parts of the Anchorage C-1, C-2, D-1, and D-2 Quadrangles, Alaska,' by G.H. Pessel, M.W. Henning, and L.E.

Burns. This open file, which covers the area west of the Nelchina Glacier and south of Sheep Mountain in south-central Alaska, sells for \$1.50.

.AOF-125, 'Reconnaissance report on surficial geology of the coastal area from Tolstoi Point to Cape Nome, Norton Sound, Alaska,' by J.R. Riehle, K.S. Emmel, and J.G. Bolm. This open file, produced in cooperation with the U.S. Geological Survey, discusses distribution of surface materials, directions of littoral transport, and rates of beach erosion for the central part of Norton Sound. The AOF has 24 pages of text, including 16 photos, and 3 blackline plates. It costs \$3.

.AOF-128, 'Map of snow avalanche paths, Seward Highway, Alaska,' by G.D. March. This AOF is a five-map report of those paths deemed hazardous to travelers along the Seward Highway, which extends from Anchorage to Seward, a distance of 127 miles, on the Kenai Peninsula. The report costs \$2.

.AOF-129, 'Slope map of part of the Seward Highway corridor, Alaska,' by G.D. March and L.G. Robertson. This, too, is a five-map open file, and depicts the relative slope of hills and mountains along the Seward Highway. It costs \$2.

.AOF-141, 'Geologic mine map, Grant Gold Mine, Fairbanks mining district, Alaska,' by T.K. Bundtzen and J.T. Kline, is a one-map representation (scale, 1":10') of the underground workings of the Grant Mine, located on Ester Dome, which is being worked today by Tricon, Ltd., of Canada. The AOF costs \$2.

DGGGS also revised an Information Circular, No. 7, 'Alaskan companies and prospectors.' This 43-page digest of the operators active in 1980 is free.

Two other DGGGS-related publications were in the news this quarter. Former DGGGS geophysicist S.W. Hackett was a senior author of a paper in the Journal of Glaciology (v. 26, no. 94). He collaborated with H.S. Santeford of the National Weather Service in Anchorage to produce a 16-page article, 'Avalanche zoning in Alaska, USA.'

DGGGS cartographer K.S. Pearson had an article entitled 'The nineteenth-century color revolution: Maps in geographical journals,' published in Imago Mundi, the journal of the International Society of the History of

Cartography. The 12-page feature described the transition of colored-map reproduction from the 19th century to the 20th---in other words, from hand-colored maps to printed ones.

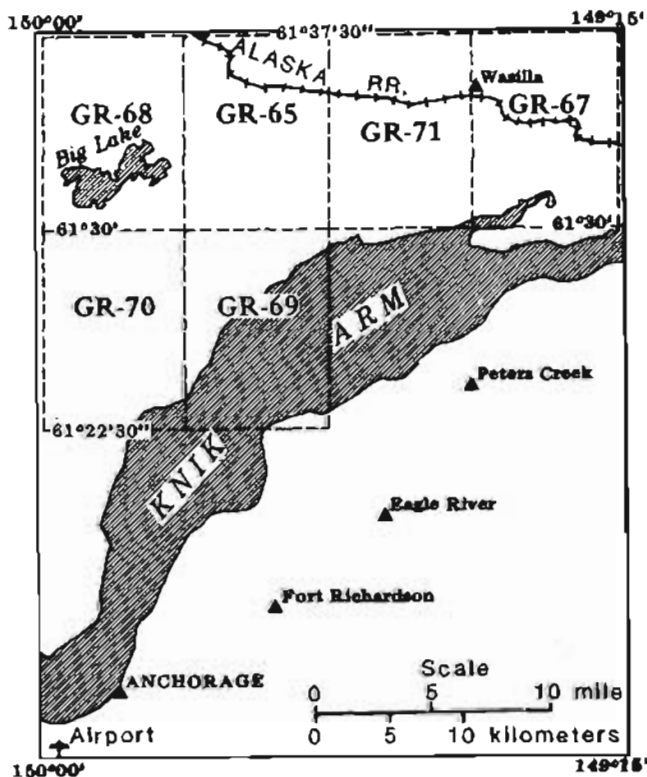


Colored maps of Mat-Su Valley available

DGGS has six new geologic reports of the Anchorage Quadrangle available for inspection and purchase. Each report consists of two multicolored maps---a geologic map and a geologic-materials map---of the Wasilla-Big Lake area.

The maps, by Richard D. Reger and Cheri L. Daniels, have an orthophoto base so that one can orient himself by man-made features such as gravel pits, roads, airstrips, blazed section lines and so forth. Each map is 28 inches high by 26 inches wide. The reports are:

Geologic report	Anchorage Quadrangle
65	C-8 SE
67	C-7 SE
68	C-8 SW
69	B-8 NE
70	B-8 NW
71	C-7 SW



Author Reger says, "The maps will be highly useful, for the area has the potential for being one of the most intensely developed areas in the state." Coauthor Daniels reinforces Reger's opinion. "The maps will be of importance to the construction people, the businessman, and the homeowners---anybody who is seriously thinking about relocating in the Matanuska-Susitna Valley," she said.

The area covered by the six reports extends from just south of Houston on the north to Goose Bay on Knik Arm on the south, and from the western end of Big Lake on the west to the Matanuska River bridge on the east.

Each geologic report costs \$6 (that is, one quadrangle set of two maps). The complete set of six reports---12 maps in all---sells for \$30, a \$6 savings over the full price.



Leases to replace claims only on some state lands

(from Fairbanks Daily News-Miner,
July 22, 1981)

Miners will probably have to change from the traditional mining claims to mineral leases only on state lands that had recognized "mineral character" at the time they were selected by the state, Commissioner of Natural Resources John Katz predicts.

The new commissioner toured Fairbanks this week, meeting with employees, legislators and individuals.

Katz said he expects the move in an attorney general's interpretation now being written on Section 6(1) of the Alaska Statehood Act. While the draft of the opinion made public last spring hinted that all state mining claims might become invalid, Katz said he believes the final opinion might strike only those lands that were considered mining land when selected.

The exact definition of "mineral character" and other details remains to be settled, Katz said. The change to a leasing system has been made easier by the passage of HB 350 by the Legislature this year, which set up a way miners could get leases on their claims easily and without stopping their operations.

In other mining issues, Katz said he opposes a severance tax on hard-rock

minerals but thinks a severance tax would be acceptable for coal.

"We have a fairly short window in which to develop a coal policy that is fully certain and discernible to people who want to buy our coal right now," he said. "Severance taxes and other broader policy issues are being handled at the Governor's Office level."

"I don't personally favor a severance tax on hard-rock minerals at this time," Katz added. "I think that would be killing the chicken before it lays the egg."

But coal is a leasable mineral, he added, and exporters buying Alaskan coal are companies used to paying severance taxes. He said a 3 percent coal severance tax would be "in the ballpark" now.

One of the department's legislative priorities next year will be a state law to take over enforcement of mining reclamation laws from the federal government, Katz said, now that Reagan administration policies have replaced the more "draconian" attitudes of the Carter administration.



Alaskan oil work summarized (from *Geotimes*, June 1981)

In what may be the last federally financed effort to find oil in Alaska's National Petroleum Reserve, the U.S. Geological Survey has awarded contracts totalling \$108 million to three U.S. companies: \$91.4 million to Husky Oil NPR Operations of Houston; \$9 million to Geophysical Service Inc. of Dallas; and \$7.4 million to Tetra Tech Inc. of Houston.

Husky, which has operated the government's exploration program since 1975, will continue the exploratory drilling and environmental rehabilitation program on the Reserve. Under its new contract, Husky has finished drilling two exploratory wells begun last year and two of four new wells to be drilled this year. In recommending that the Survey's budget for the Reserve be reduced from \$107 million in 1981 to \$2.6 million in 1982, Interior Secretary James G. Watt anticipates that private industry will take over future exploratory drilling in the Reserve, under a leasing program similar to that for other federal lands. Watt's proposed budget would

continue maintenance and operation of the Barrow-area gas field.

Geophysical Service Inc. will process 589 line miles of seismic-reflection data collected from the coastal-plain region of the Reserve. The data were gathered about May 15, when the ice was thick enough to prevent environmental damage from field operations. The information will help determine the area's subsurface geology and help locate structures likely to contain oil and gas.

Tetra Tech will help the Survey's Office of the National Petroleum Reserve monitor all planning, construction, drilling, geophysical operations, and environmental protection and rehabilitation included in the exploration program. Tetra Tech will also interpret the seismic data obtained and integrate it with existing data from the Reserve.



'Strategic minerals' to be topic of 1981 AMA Conference

The Alaska Miners Association will hold its sixth annual convention Oct. 23-24 at the hotel Captain Cook in Anchorage. The focus of the convention, 'Alaska: Strategic minerals for America,' will be presented in four sessions covering placer mining, strategic mineral deposits, regional controls for deposition, and search techniques.

The placer-mining session, chaired by Dr. Ernest N. Wolff of the UA Mineral Industries Research Laboratory, will present information on prospecting evaluation and extraction. Papers will refer to specific placer-gold and strategic-mineral properties in Alaska.

Dr. Donald L. Stevens, of Stevens Exploration Management, will present papers on deposits of strategic minerals in varying stages of exploration and development.

Dr. John Sims, Office of Mineral Development, Alaska Department of Commerce and Economic Development, will chair the session on regional controls for deposition of strategic minerals in Alaska. This session will highlight terrains in the state that are potential sites of strategic minerals.

The final session, search techniques for strategic minerals, will be chaired by Charles G. Bigalow, of WGM.

The seminar will cover current geochemical and geophysical exploration techniques used in prospecting for strategic minerals.

The Alaska Miners Trade Fair, which will be held during the convention, has both indoor and outdoor exhibit space available for rent. Floor space can be reserved by calling WGM (276-5004). For further information, contact the AMA at 503 W. 3rd., Anchorage 99501 (ph 276-0347).



Recovery of fine gold in placer operation summarized

By Cleland N. Conwell, DGGS mining engineer

(The following is an excerpt of a presentation given at the third annual Alaskan Placer Conference, Fairbanks, Apr. 2, 1981.—Ed. note)

Fine gold may be found in any placer area (Cook and Rao, 1973). As referred to here, fine gold is particulate gold that will pass a 65-mesh screen or is less than 210 microns in diameter. In a gravity concentrator, flakes of gold in the auriferous gravels react like fine gold and are often lost.

Origin of Placer Deposits

Fine gold is more likely to be found in areas with a low-energy gradient at the time of deposition. The origin of the deposit is important when considering fine-gold recovery. Wolff (1969) classified placer deposits as residual, stream, beach or marine, colluvial, and eolian. Most Alaskan gold-placer deposits are from streams and beaches. In high-energy-gradient segments near stream headwaters, auriferous gravels are poorly sorted, and fine gold may not be deposited. In marine or beach placers, the gravels or sand may be well sorted with fine gold concentrated by wave action and winnowing. The serious investigator may refer to Brady and Jobson (1973) for a report on the segregation of heavy minerals.

Mineral Recovery Techniques

There are proven gravity methods used in recovering gold. Classification or screening, which will discard a percentage of coarse material that has little or no value, may upgrade material enough to consider a more elaborate method such as froth flotation, chemi-

cal reaction, or a hydroclone (Wolff and Rao, 1981).

Nearly all mineral recovery systems start with separation of material by size, because gravity recovery systems have optimum and limiting size ranges. Willis (1979) gives a rough classification of the more commonly used feed-particle sizes for gravity separators:

25 mm to 75 μ jig	- 1" to 200 mesh
3 mm to 30 μ pinched sluices and cones	- 6 to 400 mesh
3 mm to 75 μ spirals	- 6 to 200 mesh
3 mm to 15 μ shaking tables	- 6 to 600 mesh
100 μ to 5 μ tilting frames	- 150 mesh to 5 μ

mm - millimeter, μ - micron

Recovery drops very rapidly on the lower size material without close control of particle-size range by classification.

Most gold-placer operators use a riffle sluice box, which has very low recovery of gold below 65 mesh (210 microns). However, fine-gold recovery can be improved by using corduroy, 'astroturf,' or carpets under the riffles. The slope of the sluice box should be set at an optimum grade to balance recovery with the amount of water available and still move large particles. Cook (1979) describes the velocity of water necessary to move particles up to 18 in. in diameter. Griffith (1960) describes the sluice-box arrangement for maximum efficiency.

Gold-particle Size

The size of gold particles in any one placer may be expected to fall in a fairly narrow size range. Cook and Rao (1973) show 57.68 percent of the gold in a Goldstream sample in the -6/+20 mesh size range with a very small percentage of fine gold. The first step is to determine if fine gold is present and the particle size.

Field and Laboratory Procedures

The sampling procedures must start with an adequate sample:

+10 in.	- 3 tons
+ 4 in.	- 1 ton
+ 2 in.	- 400 lb
+ 1 in.	- 100 lb
-1/2 in.	- 50 lb

If there are boulders over 10 in. in diameter, then 3 tons should be screened in the field and a 50-lb sample brought to the laboratory. If there are no pebbles over 1 in., a 100-lb lab sample should suffice.

The first step in the laboratory is to complete the screen analyses, including information from the field screening, if any. Assuming there are sufficient quantities of -65 mesh material, the laboratory screen sizes should include 10, 14, 28, 35, 48, 65, 100, 200, and 270 mesh.

The second step is to assay the size fractions to determine if there is enough fine gold to continue. If there is, the operator should consider the options open for recovery: classification or sizing, gravity, hydroclones, flotation, and chemical.

Laboratory Case Histories on Fine Gold

Before discussing recovery of fine gold, I will give an example from Cook and Rao (1973) to show you may not have a problem of fine-gold recovery. In this case, from upper Goldstream Creek, near Fairbanks, very little fine gold---about 9 percent---was present (table 1).

Table 2 is the screen analysis of the gravel. In this example 69.31 percent of the raw material could have been removed by screening without losing any gold.

An auriferous beach sand was examined to apply the recovery techniques (tables 3 and 4, fig. 2). Note that 78.14 percent of the gold is in only 2.12 percent of the original volume and that this fraction would assay 8.58 ounces of gold per ton (table 5).

Classification alone would have produced a satisfactory recovery and product, or 78.14 percent recovery and a marketable product assaying 8.25 ounces of gold per ton.

The next step was to float the various size fractions (except, for lack of material, the -150 mesh). Table 6 shows the concentrate ratio and value by froth flotation. The recovery was low (42 percent) in the -48 to +65 mesh-size fraction.

In the -48 to +65 mesh size fraction, the gold particles that floated were flaky, with the large dimension several times the size of the smallest dimension, whereas those in the flotation tails were nearly spherical. This could be expected on flotation size (Glembotskii and others, 1963). Nevertheless, 85 percent of the gold ($19.88470 \times 100/23.2941 = 85\%$) was

recovered by flotation and classification (table 7).

In this particular area, gold recovery by gravity methods alone was complicated by an abundance of garnet. For this example, classification alone or with froth flotation appear to be excellent methods of recovery.

A third example is an alluvial gold placer that may have been reworked, removing some fine material (table 8, fig. 3).

Table 9 indicates the distribution of gold by mesh size; 95.07 percent of the gold (all -100 mesh) is in 7.56 percent of the total volume and the material would assay 0.322 ounces per ton. This product would have sufficient gold to be recovered by flotation or cyanidation. Unfortunately, experimental work stopped at this point.

Summary

Fine gold, defined here as particulate gold smaller than 65 mesh, is about the smallest size that can be effectively recovered in a riffle sluice box.

If fine gold is present in the placer deposit, a controlling factor may be the origin of the deposit. There are several methods of recovering fine gold, starting with classification. Classifying material prior to recovery will remove worthless material, increase recovery, and upgrade the fine fraction for recovery of gold by flotation or other methods. If there is enough fine gold in a placer deposit, you can determine the percentage and find a way to recover it.

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- Cook, D.J., 1979, Placer gravel, in Conference on Alaskan placer mining focus: Gold recovery systems: Fairbanks, Univ. Alaska Mineral Industry Research Lab Report 43, p. 89-125.
- Cook, D.J., and Rao, P.D., 1973, Distribution, analysis, and recovery of fine gold from alluvial deposits: Fairbanks, Univ. Alaska Mineral Industry Research Lab Report 32, 101 p.

Table 1. Screen analyses of gold recovered from upper Goldstream Creek

Tyler mesh		Wt (%)	Cumulative Wt (%)	
Passed	Retained		Retained	Passed
3	8	0.00	0.00	100.00
8	20	6.59	6.59	93.41
20	28	26.03	32.62	67.38
28	35	41.12	73.75	26.25
35	65	17.11	90.85	9.15
65	100	7.63	98.48	1.52
100	-	1.52	100.00	- 0 -

Table 2. Screen analysis, Goldstream sample (from Cook and Rao, 1973)

Tyler mesh size	Wt (%)	Retained	Passing
+3	54.21	54.21	45.79
-3/+6	15.10	69.31	30.69
-6/+20	11.96	81.27	18.73
-20/+28	4.71	85.98	14.02
-28/+35	3.14	89.12	10.88
-35/+48	2.62	91.74	8.26
-48/+65	1.13	92.87	7.13
-65/+100	0.84	93.71	6.29
-100 +	6.29	100.00	- 0 -

Table 3. Screen analysis, beach gold placer

Tyler mesh size	Wt (%)	Percent	Retained	Passing
+28	22	4.91	4.91	95.09
-28/+35	73	16.30	21.21	78.79
-35/+48	144	32.16	53.37	46.63
-48/+65	193	43.10	96.47	3.53
-65/+100	6.3	1.41	97.88	2.12
-100/+150	8.0	1.79	99.67	0.33
-150	1.5	0.33	100.00	- 0 -
	447.50	100.00		

Table 4. Gold distribution, beach sand

Tyler mesh size	Wt (%)	Assay (oz/ton Au)	Total gold (%)
+28	4.91	- 0 -	- 0 -
-28/+35	16.30	0.0127	0.89
-35/+48	32.16	0.0718	9.91
-48/+65	43.10	0.0530	9.81
-65/+100	1.41	0.2062	1.25
-100/+150	1.79	4.2477	32.64
-150	0.33	32.1200	45.50
	100.00		100.00

Table 5. Assay value of -100 mesh fraction, beach sand

Tyler mesh size	Percent total weight	Assay (oz/ton Au)	Product
-100/+150	1.79	4.2477	7.60
-150	0.33	32.120	10.60
	2.12	8.25	18.20

Table 6. Concentrate ratio and value by froth flotation

Tyler mesh size	Wt (%)	Concentrate ratio	Assay (oz/ton Au)	
			Conc.	Tails
+28	not floated	- -	- -	- -
-28/+35	16.30	80.11	0.664	0.0035
-35/+48	32.16	130.11	5.298	0.0287
-48/+65	43.10	134.1	6.005	0.0309
-65/+100	1.41	188.1	32.668	0.0303
-100/+150	1.49	356.1	1266.75	0.0696
-150	not floated	- -	- -	- -

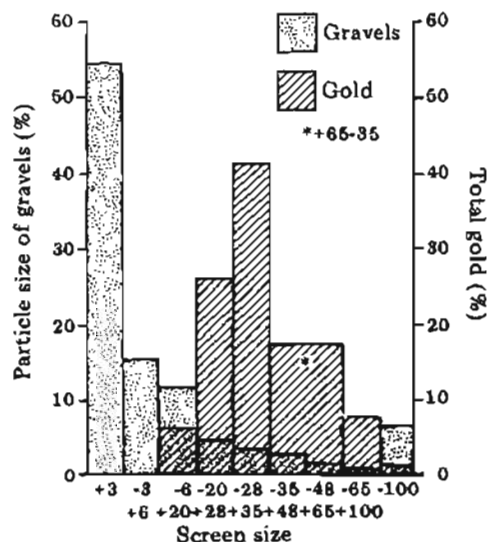


Figure 1. Particle size of gravels and gold from Goldstream (Cook and Rao, 1973).

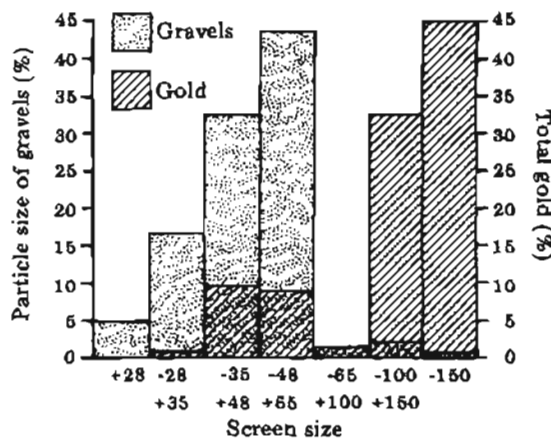


Figure 2. Particle size of sand and gold from a beach placer.

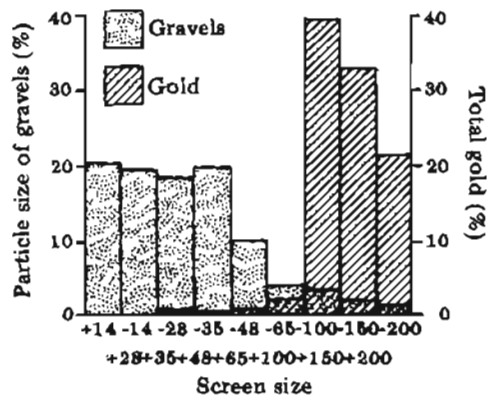


Figure 3. Particle size of gravels and gold from an alluvial placer.

Table 7. Gold recovery by froth flotation.

Mesh size	Percent	Assay	Product	Recovery by flotation	Factor
+28	4.91	- 0 -	- 0 -	- 0 -	- 0 -
-28/+35	16.3	x 0.0127	= 0.2070	x 0.73	= 0.15111
-35/+48	32.16	x 0.0718	= 2.3091	x 0.60	= 1.38556
-48/+65	43.15	x 0.0530	= 2.2843	x 0.42	= 0.95941
-65/+105	1.41	x 0.0062	= 0.2907	x 0.86	= 0.25291
-105/+200	1.75	x 4.2277	= 7.3936	x 0.86	= 6.33491
-200	0.33	x 12.1200	= 4.0000	x 1.00	= 4.00000

Table 8. Screen analysis, alluvial gold placer

Tyler mesh size	Wt (g)	Percent	Retained	Passing
+14	100	20.01	20.01	79.99
-14/+28	96.6	19.33	39.34	60.66
-28/+35	93.2	18.65	57.99	42.01
-35/+48	99.7	19.95	77.94	22.06
-48/+65	51.8	10.37	88.31	11.69
-65/+100	20.60	4.12	92.43	7.57
-100/+150	18.90	3.78	96.21	3.79
-150/+200	10.60	2.12	98.33	1.66
-200	8.30	1.66	- 0 -	- 0 -
	499.70	99.99	100.0	

Table 9. Distribution of gold by wash size, alluvial placer

Tyler mesh size	Sample (wt %)	Gold assay	Product	Distribution
+14	20.00	0.009	0.000	0.00
-14/+28	19.32	0.000	0.000	0.00
-28/+35	18.69	0.001	0.019	0.06
-35/+48	19.94	0.001	0.020	0.69
-48/+65	10.37	0.002	0.021	0.73
-65/+100	4.12	0.020	0.082	2.85
-100/+150	3.78	0.390	1.134	39.40
-150/+200	2.12	0.460	0.975	33.88
-200	1.66	0.378	0.627	21.79
	100.00	0.029	2.878	100.00

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New employees listed

More new faces continue to be seen around the confines of DGGs. Among the new employees are a geologist, a hydrologist, two geological assistants, and a clerk-typist. In addition, there is an array of DNR student interns who are assisting the staff in the field, the office, and the assay lab.

The new geologist in the fold is Ellyn E. Gressitt, who is working on the Brooks Range mapping project. Ellyn has a B.A. from the University of Montana, is single, and likes running, skiing, and juggling.

At the new Eagle River facility is hydrologist Mark G. Inghram, who joined DGGs in May. Inghram, formerly with the U.S. Forest Service in Sitka, has a B.A. in geology from Colorado College and an M.A. in hydrology from Colorado State University. He is working primarily on the Navigability study (p. 2). Mark is single and likes outdoor activities.

In College, geological assistant Steven B. Hardy is working on the North Slope and peat projects (p. 3). Steve has a B.S. in zoology from Iowa State University and is writing his M.S. thesis in geology at UA. He and his wife, Catie, have no children.

Also in College is Roy D. Merritt, 28, who is pursuing his Ph.D. in coal geology at UA. Merritt, who is working on the Coal Investigations project in the Susitna River area, has a B.A. in geology from Berea College and an M.S. from Eastern Kentucky University. A bachelor, Roy likes hiking, camping, spelunking, and XC-skiing.

DGGs has a replacement for publications clerk Geri Broker, who transferred to the Dept. of Public Safety in Tok. The new clerk is Fairbanksan Donna J. Mursch, a 1979 graduate of West Valley High School. Donna is unmarried and likes camping.

Congratulations are in order for two DGGs Anchoragites---Patti Coonrod, who was promoted to Secretary, and Jay Newgaard, who became a new papa. Sally Newgaard give birth to a 10-lb, 2 oz boy, Nicholas Adam, on July 18.

DGGs starts big resource mapping program

When State Geologist Ross G. Schaff talks about gearing up for 'the big push,' chances are he's referring

to the \$8.6-million capital-improvement budget that the state legislature and the governor authorized to begin map-

ping the 104 million acres allotted to the state in the Alaska Lands Bill, signed by Congress last winter.

Schaff believes the effort, which will take 15 to 20 years, will have an immense impact on the state. "We have very little information on our state," he said. "We need to get out and map our land to evaluate our resources---not only for oil and gas, but for vegetation, coal, uranium, water, geothermal sites, and minerals," Schaff added.

The first step in the mapping is a 5-year plan that will complete 15 to 20 percent of the goal. Resource mapping is sorely needed, he says. "The Arctic Wildlife Range controversy is a classic example. The pros and cons of arguments were befuddled by the lack of real information." Less than 10 percent of the state has useful geologic maps today, he estimated.

"But with detailed mapping," Schaff said, "decision makers will have valuable information on hand for lease sales, land sales, lotteries, protection, and land swaps. Moreover, management of industry will have a basis for determining whether additional investments should be made in the state."

In a preliminary 5-year resource evaluation and mapping plan, more than 300 1:63,360 quadrangles throughout the state have been tentatively selected for detailed mapping. The evaluation process for most of the regions selected involves four steps---compilation of existing data, data collection and analysis (field and lab work), computer modeling, and publication.

The final products will include maps of mineralized regions, surface and ground water, land cover, surficial geology, construction materials, avalanche zones, agricultural soils, seismicity, permafrost hazards, and geothermal energy.

Some increase in staff is anticipated, but a little more than half (54 percent) of the total will go to contractual services. Alaskan college students, both graduates and undergraduates be employed as 'student interns' in the Department of Natural Resources, working in the field and in the office. In addition to the pay, some will receive college credit for their summer efforts.

DGGS has begun planning in detail field activities for next summer's field work. "Some programs will begin this summer but the late adjournment of the Legislature presents some problems for this field season," Schaff said. "Nevertheless, many usable compilations will be forthcoming during this fiscal year," he stated.



Our Gague....

By Frank Larson, DGGS editor

Like a little levity? We have lots of news, so here's very little: 'Thirty-seven.'....Inside prisons, this punchline is a classic, even funnier than 'Fifty-eight' or the immortal 'Ninety-three.' (Cons, you see, are jaded---so jaded, in fact, that they simply number the jokes in their vast repertoire. Then, whenever anybody feels like telling a joke, he simply yells out the number. And then, you see, they all... Oh, forget it. Some people just can't tell a joke)....Here's another try at a little levity: 'Rats. I'm on sacking and pillaging again.' (A Goth, reading company orders posted on a tree, to his buddy.)....All right. So it's not 'Laugh-in.' But look at our motto, 'E pluribus nil.' That's Roman, you know, for 'From the many, nothing.'....Now there was a jaded group, those Old Lats. They really got caught with their togas down. You see, as Attila was hammering his company orders to a tree outside Rome; the world's first Latin scholars were inside the city gates, boogeying and eating grapes. Few know it, but as Attila was giving a prepillaging pre-Rockne pep talk to his Fighting Huns, the Roman revelers were boozily bellowing a popular song of the day, the haunting theme from the latest Charleton Hestonelius movie, 'Ni illitimi carborundum sub.' The flick, a sci-fi epic about an invasion by a band of vagabond Croatian knife sharpeners, prophesied doom for the Roman Empire. Typically, the message was wasted on the wasted Romans. They still let the ba****ds grind them down....Now for the news....Texaco is going to spend \$50M to modify its Anacortes, Wash. refinery over the next 2 yr to handle Alaska crude. You see, our oil is 'cruder' (higher sulfur content) than Alberta's, which the plant

was designed to handle when it was built in 1958....Former DNR head Chuck Herbert has been elected president of the Resource Development Council. He has served as their staff consultant on mining for the past 3 yr....Alaska Pacific Bank has a new department to deal with all NRG-related industries, including coal, hydroelectric, and petrochemical....Also in Anchorage, the State Recorders Office has moved. In mid-May they moved from the State Court Bldg to the Australaska Bldg, 1001 W. 4th (ph 274-5576)....Oil production in Cook Inlet will drop by 15.5% from last yr, to an avg daily production of 83,836 bbl, according to the Alaska Oil and Gas Conservation Commission. (Q: Was the originator of 'bbl' the same misguided soul who came up with 'lb'?)....An earthquake registering 5.8 hit the Iliamna Volcano area, 130 mi SW of Anchorage, on July 31. No injuries reported....A 6.9 quake hit the Rat Islands in late January. (The word just got out.) No injuries there, either, but the tree in the Aleutians National Forest got bent....Here's one to make you feel better all over: Dr. John Huchra of the Harvard-Smithsonian Center for Astrophysics says the Earth formed with the 'Big Bang' a mere 9 billion yr ago, not the 18 b.y. ago as previously thought....Later (9 b.y. plus 2, to be exact), DGGs Director Ross Schaff will host the 1983 annual meeting of the Association of American State Geologists. He'll empanel his colleagues in Anchorage....Meanwhile, the 4th Int'l Conference on Permafrost has set aside July of that year to meet (presumably 'over a cool one') at the UA Fairbanks campus....Callahan Mining, which owns 80% of Livengood Placers Inc., started stripping overburden in January for summer sluicing of its gold-bearing gravel. Asamera Oil had drilled the property but was replaced by Canadian Natural Resources as operator....In Southeastern, Cusak Industries and Alaska Gold Mines are building a \$500K placer mining plant at their Yakataga Beach project. Cusak (40% owner) will manage....Also in SE, Noranda announced plans to begin producing lead, zinc, and silver ore from its small-but-high-grade Greens Creek property on Admiralty Island no later than 1985. The deposit has estimated reserves of \$800M and a life of 10 yr. Noranda has opened a 4,400-ft adit and

is bulk sampling. Plans call for barging the ore from Hawk Inlet; the 750-tpd plant will have about 250 employees, some of which may be transported from Juneau, 10 miles NE....U.S. Borax will begin an adit this year to intersect the core-sample bores on its Quartz Hill moly property....Borax, incidentally, hired a Denver firm to research the economic and social effects of its planned 60,000-tpd mine on the denizens of nearby Ketchikan; the resultant report will be used by community leaders for planning....We know of one gal they may want to interview--the one who wandered into our Ketchikan office in May asking about a job 'mine sitting' (a new job description, that). Seems she needed a place to live so that she could get her children out of protective custody....A thousand leagues to the west, the Orientals are switching from Mid-East oil to Alaskan coal to meet their NRG needs. Sun Eel Shipping has agreed to buy more than 7M tons of coal from Alaska's sole operating mine, Usibelli, over the next decade. The South Korean firm originally planned to build a loading dock in Anchorage, but canceled plans because of unstable soil conditions. Instead they will ship their megaton cargo by rail to ice-free Seward, on Prince Wm Sound. Earlier, Tohoku Electric of Japan inked a 9-yr pact with a 6-yr option with Montana Development to ship Usibelli coal from Seward to other Pacific Rim countries.. A word to our brethren in the USGS: Fondle your rock hammers and Bruntons while you can, for if the 5/12 issue of the American Mining Congress News Bulletin is right, you may be in for a change in your professional life style. In discussing the roles of the USGS and the USBM in the proposed National Mineral Security Act of 1981 (title IV), the Bulletin said that the Bureau of Mines is 'designated as the principal federal agency for the mineral data collection and analysis.' If that's not a typo, fellas, Maalox is going to be a hot stock on the Big Board....And finally, a fond look backward at the 1970s, where the two most revolutionary changes in lifestyle had to be the invention of the microfiche and the silicon microprocessing chip. This era will doubtlessly go down in history as The Age of Fiche and Chips....(Well, we promised only a little levity.).Cheers.

Metals Market

	<u>July 24, 1981</u>	<u>3 Months Ago (4/20/81)</u>	<u>1 Year Ago (5/16/80)</u>
Antimony metal per lb, NY dealer	\$ 1.38	\$ 1.39	\$ 1.53
Barite (drilling-mud grade per ton)	\$ 32-61	\$ 30-60	\$ 24-47
Beryllium ore, stu*	\$130.00	\$100-130	\$ 50-55
Chrome ore per long ton (Transvaal)	\$ 55.00	\$ 54.00	\$ 54.00
Copper per lb (MW-prod)	\$ 0.82	\$ 0.848	\$ 0.90
Gold per oz	\$410.60	\$478.88	\$270.90
Lead per lb	\$ 0.42	\$ 0.38	\$ 0.51
Mercury per 76-lb flask	\$440.00	\$420.00	\$325.00
Molybdenum conc. per lb (Climax)	\$ 8.70	\$ 8.75	\$ 6.84
Nickel per lb (cathode)	\$ 3.00	\$ 3.08	\$ 2.85
Platinum per oz	\$407.00	\$458.80	\$449.00
Silver, New York, per oz	\$ 8.46	\$ 11.14	\$ 8.77
Tin per lb, MW composite	\$ 6.44	\$ 6.80	\$ 7.38
Titanium ore per ton (ilmenite)	\$ 70.00	\$ 70.00	\$ 50.00
Tungsten per unit (GSA domestic)	\$133.00	\$130.00	\$125.00
Zinc per lb (MW-US PW)	\$ 0.46	\$ 0.42	\$ 0.39

* - Standard ton unit (20 lb)

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