MP-11 Bundtzen, T. K., pp. 8-14.

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DGGS Staff Begins Annual Trek to Bush

A full slate of geologic studies got underway this month when members of the DGGS staff began to trickle into the bush for their annual summer field season. The activities this summer will range from Wiseman to Wasilla and from Nondalton to Nunivak Island. Logistical support will also have a varied appearance, with conveyances running the gamut from helicopter to horse to plain old-fashioned 'hoofing it' on foot. The field parties, purposes, and dates are listed below.

Geologic Investigations

Date	Personnel	Purpose
6/5-6/15	Eakins, Gilbert, Bundtzen, Kline, Laird	To complete the 1:63,360 mapping began in 1977 of the central Lake Clark quadrangle, which is part of the proposed Lake Clark National Park (3.14 million acres) and to evaluate the mineral potential for possible state land selection. (Helicopter and fixed wing.)
6/15-8/1	Dillon, Pessel, Henning, Price	To continue the regional mapping (1:63,360) of the Wiseman quadrangle started in 1977. Geophysical investigations and geochemical sampling to be included, with emphasis on mineral potential and tectonics. (Helicopter.)
6/15-6/22	Riehle, Howland, Emmel, Price	To investigate the geology and conduct a geologic hazards study of the west side of lower Cook Inlet from Tuxedni Bay to West Forelands; will include photointerpretation and surficial mapping (1:63,360). (Helicopter.)
6/20-8/8	Reger, Carver	To study the surficial geology of 13 orthophoto maps (1:250,000) in the Wasilla-Palmer area for general use and planning by the Mat-Su Borough and DNR Planning and Research. (Helicopter, truck.)
6/16-8/8	Kline	To conduct surficial-geology mapping (1:63,360) of headwaters of Little Susitna River area as part of an overall plan to map the

		eastern Susitna River basin, Matanuska Valley, and southwestern Talkeetna Mountains area for planning by Division of Parks and DNR Planning and Research. (Pack train.)
6/23-6/30	McGee, Howland	To conduct reconnaissance geology of the west side of the Susitna basin, with emphasis on coal. (Helicopter, truck.)
6/23-6/30	Long, Price	To inspect Beluga coal field with emphasis on hydrology to obtain baseline data for future development. Cooperative program with USGS. (Truck.)
7/1-7/15	Lyle, Palmer (USGS) Morehouse	To conduct mapping, geochemical sampling, and petroleum studies of the Norton Sound area, including Nunivak Island. Cooperative effort with USGS. (Helicopter.)
7/10-8/30	Bundtzen, Gilbert	To continue 1977 investigations of the Kuskokwim area (Stony and Swift Rivers) with emphasis on mineral potential and interpretation of general geology. (Helicopter.)
7/15-7/31	Riehle, Bohm (USGS) Emmel	To make photointerpretation, look for construction materials, and conduct oil-related geologic studies of the coastline of Norton Sound. Cooperative program with USGS. (Helicopter.)
8/24-8/31	Reger, Kline	To complete mapping (1:63,360) of bedrock and surficial geology of Big Delta A-4 quadrangle area. (Canoe, truck.)
May, June	Long, Howland	To investigate the Chena River flood plain for Division of Parks, with emphasis on surface waters and flooding potential. (Truck.)
Undated	Conwell, Triplehorn (UA)	To investigate the Galena-Unalakleet area for coal and uranium, and the neighboring Yukon River area for coal. (Fixed wing.)
Undated	Eakins	To visit the mining districts of the interior. (Truck.)
Undated	Eakins	To visit the mining districts of Southeastern, particularly Quartz Hill, Bokan Mountain, and Admiralty Island. (Fixed wing.)
Ongoing	Long, Howland, Price	To continue the hydrological investigations of the Wasilla area, including ground-water features, and water quality. Continuation of 1977 cooperative program with USGS. (Auto.)

Geophysical Investigations

6/15-6/26	Hackett	To conduct gravity and ground magnetic surveys and a rock-sampling program (for physical-rock properties) in the Wiseman quadrangle. (Helicopter, inflatable boat.)
6/15-6/26	Emmel, Price	To collect gravity data on west side of Cook Inlet. (Helicopter, boat.)
6/22-7/1	Price	To collect gravity data and rock samples for density values in Beluga coal field. (Helicopter.)
7/1-7/15	Morehouse	To collect gravity data in southern Norton Sound area. (Helicopter.)
7/16-7/31	Emmel	To collect gravity data in northern Norton Sound area. (Helicopter.)
Summer	Hackett	Aeromagnetic survey in Survey Pass, Wiseman, Shungnak, Bettles, and Hughes quadrangles under contract to Geometrics, of Sunnyvale, CA (12,600 line miles).

Weather or Not

(from Department of Wildlife Resources)

Now an absolutely foolproof weather-forecasting tool has been discovered. Known as the weather rock, the device is ingenious in its simplicity. A round and very smooth rock is hung from a rope just a few inches off the ground. Then a circle is drawn around the rock and, with the aid of a compass, stakes are driven and marked to represent north, south, east, and west.

But the key to the weather rock's success is its prognostication formula: 1) If the rock is wet, it may be raining; 2) if the rock is hot and dry, the sun may be shining; 3) if the rock is warm and dry, the sun did shine; 4) if the rock is damp and cold, it's probably cold; 6) if the rock is swinging toward a point rock, the wind may be blowing in that direction; 7) if the rock is swinging at a 45° angle, there is a good possibility of a tornado; and 8) if the rock is gone, you'd better go too.

There has been some reluctance on the part of certain experts to give their endorsement to the device until further field tests results are in; but for the moment, the only alternative that is anywhere near as accurate is a look out the window.

LeResche Testifies Before Congress on H.R. 39

(Excerpts of the testimony of Dr. Robert E. LeResche, DNR Commissioner, before House Merchant Marine and Fisheries Committee regarding H.R. 39, Washington, D.C., April 4, 1978)

I want to outline briefly the background behind the State's wish to achieve conveyance of certain lands that are also proposed for refuge status. Last August in his testimony before the House Subcommittee on General Oversight and Alaska lands in Fairbanks, Governor Hammond requested conveyance of its remaining Statehood Act entitlement and selections as part of the d-2 legislation. He further announced that the State would identify a pool of lands suitable for state selection purposes from federal and native overselected lands in Alaska and communicate this information to Congress for conveyance and boundary adjustment purposes. The Governor announced our intent to have 25 to 30 million acres conveyed. The Governor's announcement set in motion an effort resulting, first, in the preliminary identification of a 41-million-acre land pool which was brought to the attention of Congress last November. Since this tentative identification, the Department has conducted a series of meetings across Alaska to obtain public comments and recommendations on these state selection interest areas.

As you know, the Alaska Statehood Act gave the State selection rights to roughly 104 million acres within 25 years of statehood. These rights, not yet fully exercised at the time of the land freeze in 1968, have been altered in character by the Native Claims Settlement Act and the related legislation before you. The Governor instructed us to identify the 41-million-acre pool of lands for conveyance according to these principles: that the best mineral, oil and gas, settlement and agricultural lands should come to the State, and that where the State's interest would allow, that land management patterns and the national interest in conservation systems be prominently considered.

Selected on this basis, our interest pool includes only 5.6 million acres that conflict with the refuge proposals before you. The State strongly feels that (1) these lands are much better suited to state ownership than to refuge status because of their resource values and (2) that these lands can be conveyed to the State—to the State's very significant benefit—without materially affecting the values of the proposed refuges.

Yukon Flats Wildlife Refuge: The State has indicated a desire to select approximately 3 million acres, or 23 percent of the proposed Yukon Flats Wildlife Refuge, which includes a gross area of 13.2 million acres.

The area on the east side of the proposal contains the communities of Circle, Circle Hot Springs, and Central which are located on the Steese Highway. Resource values on the lands included in the state interest area to either side of this established transportation corridor include high values for hardrock minerals, agriculture, foresty, and recreation. It should also be noted that this is one of the few and only areas to the east of Fairbanks where the State may gain access to the Yukon River. There is especially high agriculture potential along the bench lands just to the north of Circle on the north side of the Yukon River which the State has a great interest in selecting.

The State contends without any qualification that this area should be excluded from the Yukon Flats Wildlife Refuge boundaries and made available for selection by the State of Alaska.

The State interest areas on the western side of the Yukon Flat proposal also follows an existing transportation corridor, the North Slope Haul Road, and was identified for a variety of reasons. The State of Alaska wishes to obtain lands along the North Slope Haul Road corridor north of the Yukon River as well as maintaining access to the Yukon River from the south. A bench above the Hodzana River which overlaps the refuge proposal was identified due to its high land capability and agricultural potential. This interest area was identified with consideration of access requirements for eventual marketing of agricultural products via the North Slope Haul Road. This is also a high-priority selection area for the State of Alaska.

Marsh Creek Anticline area of Arctic Wildlife Range: Within the present Arctic Wildlife Range, the State has identified an extremely important interest area along the Beaufort Sea coast in the northwestern part of the existing Arctic National Wildlife Range. The area includes the famous Marsh Creek Anticline structure, which ranks as one of the top prospects for upland oil and gas deposits in the entire state and perhaps the entire continent.

Interest lands within the proposed extension of the Arctic National Wildlife Range: This area overlaps part of the 11 million acre Arctic Wildlife Range additions. The primary state selection interest is the combination of hard-rock mineral values, wildlife habitat, and recreation and hunter-access considerations. This represents the possibly only portion of the Brooks Range which the State would own after passage of d-2 legislation.

Bethel interest area of proposed Yukon Delta National Wildlife Refuge: State interest lands in this refuge proposal comprise only 90,000 acres out of the total gross proposal area of 18.7 million acres, or 1/2 of 1 percent. The primary purpose in identifying these state lands is to provide river access and state land adjacent to a rapidly growing population center and in rural Alaska.

Proposed Nowitna National Wildlife Refuge: State interest lands within the Nowitna Refuge comprise 185,000 acres, or 12 percent of the proposal's gross area of 1.5 million acres. Outstanding values of this state interest area include its proximity to and access to the Yukon River, and values for agriculture, forestry, and land-settlement capability.

Proposed Tetlin National Wildlife Refuge: State interest lands within the Tetlin proposal comprise

some 47,000 acres, or 4.7 percent of the proposal's gross area. The five townships of state interest land are located along the Alcan Highway between the U.S.—Canadian border and existing state lands, the main highway connection between Alaska and the south-48 states. This area would be developed as a state recreation area including camping, picnic facilities, trail systems and information programs about the State of Alaska.

PROPOSED ADDITIONS TO NATION WILDLIFE REFUGE SYSTEM: The Committee has requested comment on specific refuge proposal areas which are not included in the current H.R. 39 draft or the Administration d-2 proposal. These areas included the Copper River Delta, the Seward Peninsula, and specific areas within the National Petroleum Reserve.

Copper River Wildlife Refuge Proposal: This proposal, which encompasses 1.37 million acres, generally covers a region of the existing Chugach National Forest. It also includes 340,000 acres of State land and 152,000 acres of Native selections which we expect to eventually be conveyed to Native Corporations. The refuge proposal area has high resource values of several kinds. More than two-thirds of the proposed refuge areas has high timber values and excellent oil and gas potential. The area contains over 150,000 acres with coal potential in the Bering River coal-field region and some hard-rock mineral potential. The wildlife values of this area are also extremely high.

In view of the region's high resource values, the existing management protection of the wildlife in the area, the inclusion of state inholdings, and the general importance of certain islands in the area to future commence and petroleum development, the State feels refuge designation is totally inappropriate and unnecessary in the Copper River Delta. This contention is further supported by the importance of the area as a commercial center.

"The EPA has made it illegal for him to go to the bathroom."

—Reprint courtesy Arizona Small Mine Operator Ass'n.—

Seward Peninsula: Approximately 2.7 million acres of the northern half of the Seward Peninsula is currently part of the proposed Chukchi-Imuruk Monument area. Nearly 1 million acres of the area is rated high for hard-rock mineral potential, with wildlife habitat the other outstanding value of the area. The reindeer industry uses this region as well as much of the rest of the Seward Peninsula for reindeer grazing.

The State prefers a management system for this area which would allow for wise development of its mineral and reindeer-grazing potentials, and therefore favors either retention as unreserved public domain, inclusion in a cooperative management system or, less favorably, a refuge or preserve managed under special principles to guarantee these uses.

National petroleum reserve areas (Teshekpuk Lake; Utukok River): Teshekpuk Lake, in the northern part of National Petroleum Reserve-Alaska, has extremely high oil and gas potential, and the State has a high interest in obtaining via selection or land exchange the subsurface rights to this region. Consequently, we oppose refuge designation as detrimental to both oil development and state land selection efforts. Clearly, however, the area is important to waterfowl and surface management should take this into account, regardless of ownership. Refuge status is simply not necessary to properly protect those other values. Here again, a cooperative management system would be ideal.

The Utukok River area is clearly critical to the Arctic caribou herd but, again, surface values are adequately protected under existing statute and refuge designation is unnecessary and potentially obstructive.

Offshore boundaries to wildlife refuges: The Committee requested a statement of the State's position on the appropriateness of a 6-mile seaward offshore boundary around new and existing wildlife refuges and whether or not the State preferred this approach or some manner of cooperatively managing the seaward boundary on wildlife refuges. The State owns the tide and submerged lands to a distance of 3 miles off all lands of the State of Alaska, and we strongly assert that these lands must not be included within refuge boundaries. Such an inclusion would severely detract from state prerogatives for use of our lands, and would result in an inverse condemnation situation, in which the people of Alaska would be deprived of their Statehood-right authority to manage the area's fisheries or develop mineral resources. We would consider any such action a most severe breech of the Statehood compact and would be forced to act accordingly.

Arctic Wildlife Range oil and gas survey: Section 604(b) provides for exploration and survey of a portion of the Arctic Wildlife Range for oil and gas potential.

The State of Alaska believes this provision is a great step forward in ensuring that appropriate energy sources are identified and available for national use. We therefore support exploration of the most promising areas of the Range, under strictly controlled conditions. However, the State of Alaska contends that it is in the

highest national interest to have the subsurface rights to portions of this area conveyed to the State as part of a land exchange effort. The Governor has identified it as a potential area to be used by the Federal Government in land exchanges for state inholdings within other park and refuge areas. Such exchange action could ensure that the environmental cost of providing for exploration and development of this area of the Arctic Wildlife Range would be compensated by receipt of certain state inholdings to be included in proposed parks and refuges. This is clearly a mutually beneficial arrangement.

Provisions for mining and mineral exploration: The Committee has requested the State's position on H.R. 39's proposal for mining and mineral exploration within proposed and existing refuges. The State believes the mineral process outline in Title VIII of H.R. 39 is overly cumbersome, impractical, and effectively closes these areas to mineral exploration possibilities. The Title VIII provisions are more stringent and cumbersome than existing laws governing mineral use in these areas. Consequently, the State believes that existing law is clearly more acceptable than a provision set forth in Title VIII for mineral exploration within refuge boundaries.

More important, however, we believe that existing law is itself also inadequate for protecting mineral development requirements within new refuges. Very little is known about the mineral resource base in most of Alaska, and as a consequence providing for exploration opportunities is necessary if we are to assure availability of minerals for those areas in future times of need. The State thus prefers a policy on refuges which allows exploration to take place under specified guidelines and standards, protecting surface values but providing important mineral information. We specifically support the approach set forth in Senate Bill 1787. Once again, such exploration could best be carried out compatibly with surface values, under a good commission-oriented cooperative management system.

Wilderness Designation for refuge units: The State of Alaska believes that adequate study should precede designation of wilderness areas.

The State definitely feels that H.R. 39 is recklessly excessive in the designation of wilderness areas and that the vast majority of these areas have not been adequately studied or justified for wilderness designation.

Transportation, utility, and access provisions for wildlife refuges: The Committee has requested comment on the preferability of the language set forth in Title X of H.R. 39 compared with current statutes regarding access provisions across refuges. The present statutes state that the Secretary of Interior may grant rights of way across existing refuges for a variety of purposes. The Secretary must show that the uses are compatible with the purposes of the refuge. The language in Title X of H.R. 39 does not abrogate this right since the process for transportation access is limited to management systems which currently do not have provisions for transportation access under existing statute. Consequently, a comparison of the two seems irrelevent assuming the refuges remain in refuge and not wilderness status.

If wilderness classification is put on the refuges, however, the current statutes do not provide for any method of providing transportation and utility corridors across wilderness designated areas. Consequently, the language in H.R. 39 would then be in fact applicable. The language in H.R. 39, however, creates an entirely too cumbersome and lengthy process to adequately provide for transportation access needs. The state position on this issue is thus that these refuges should not be designated wilderness areas due to the impact it would have on transportation corridor access as well as other activities unless adequately studied and justified, and that in general transportation access provisions would follow the stipulations set forth in Senate Bill 1787. Senate Bill 1787 guarantees needed public access in accordance with land use plans promulgated by a federal-state land use planning commission or authority.

Mr. Chairman, the State of Alaska has made every effort to be reasonable on the d-2 issue. We have been so reasonable, in fact, that we have more than once incurred the ire of some of our more conservative citizens, including our beloved and esteemed Congressmen for all Alaska. We have sought to make boundary changes based on the best resource knowledge available, rather than an emotion. We have sought to amend, rather than oppose, whether possible. We have achieved much for Alaskan citizens and all Americans in this way, *but we have not yet achieved enough*. H.R. 39 is severely deficient in several ways, and the State clearly opposes it as presently written. Congress must:

- Alter boundaries in legitimate state selection interest areas to convey land with high agricultural, mineral, and settlement value to the State as contemplated in the Statehood Act.
- Provide a better mineral access mechanism in certain areas.
- Recognize State sovereignty on tide and submerged lands.
- Maintain the State's rights to manage resident fish and wildlife.
- Assist in creating more national management units in conveying mineral rights in high potential areas to the State in exchange for certain inholdings.
- Refrain from establishing 'instant wilderness' in

The Finite Age Date. A UA geology prof tells of a guided bus tour of the Honolulu area. During the course of the narrated trip, the bus passed a lava formation and the driver announced that it was '4,000,004 years old.' Later, the tourist bottonholed the driver and asked him how he arrived at such an exact age date. "Well," said the driver, "I had a geologist on the tour once, and he told me the rock was 4 million years old. That was 4 years ago."

favor of requiring thorough study and consideration.

- Establish a true cooperative management system for the collective good of the Nation and the State.

Members of the Committee, the State of Alaska has said that the acreage count is much less important than where the lines are drawn and what management systems are put in place. Alaska could conceivably thrive under an 80-million-acre d-2 act, if you deal well with the crucial issues we have outlined; or she could flounder and die under a 50-million-acre d-2 act, if you neglect these issues or deal poorly with them.

Geologic Report, DNR Annual, and Two AOFs Released

A geologic report, the DNR annual report, two open-file reports, and an updated information circular are now available from the DGGS mining-information offices (p. 1).

Geologic report 58, which delineates the geology of Ruby Ridge, located between the Ambler and Shungnak River in the southwestern Brooks Range, has been released. The study was written by W.G. Gilbert, M.A. Wiltse, and S.W. Hackett of DGGS and J.R. Carden and R.B. Forbes of the UA Geophysical Institute. The report has a 1:31,680-scale multicolored map and sells for $2.50. The abstract follows.

Ruby Ridge contains a polymetamorphic assemblage of pelitic schist and lesser amounts of metabasite, metafelsite, and marble. Pelitic schist is generally muscovite-quartz schist but includes chloritoid-bearing, graphitic, and calcareous units. Metabasite lenses within the pelitic schist vary between glaucophane-bearing and greenschist varieties. Most of the pelitic schist, marble, and metabasite was metamorphosed in the blueschist facies in late Precambrian time. The metafelsite generally contains biotite and microcline and is either of mid-Paleozoic or Cretaceous age. Weakly metamorphosed rocks on the tip of the ridge are probably either continuous with Paleozoic rocks in the Cosmos Hills or are the low-grade part of a progressively metamorphosed terrane.

Greenschist-facies metamorphic segregation, thrust faults, and isoclinal to subisoclinal folds overturned to the north developed during widespread Cretaceous tectonism and plutonism. Open to subisoclinal folds, slip cleavage, and, perhaps, the Kalurivik Arch formed during Late Cretaceous or Tertiary time.

Linear zones of high magnetic intensity lie over the Cosmos Hills and uplands of the Baird and Schwatka Mountains. Broad magnetic lows and highs occur over the southern portion of the schist belt, and flat magnetic lows occur over the Ambler Lowland. The aeromagnetic evidence suggests that the tectonic boundary between the Cosmos Hills-Angayucham terrane and the schist belt was reactivated as a strike-slip system during Tertiary time.

Also available are two-open-file reports, one a joint study with the USGS on the North Kenai area and one describing the surficial geology of part of Prince William Sound. They are:

AOF-112, "Selected hydrologic data related to water-table aquifer of North Kenai, Alaska," by M.D. Howland and G.W. Freethe (USGS). The AOF consists of one plate with water-table contours (1:63,360 scale), nine lake hydrographs, six well hydrographs, and two precipitation records. It costs $1.50.

AOF-115, "Preliminary photointerpretation map of the surficial geology from Rude River to Valdez Arm, Alaska," by J.R. Riehle. This report also consists of one plate (scale 1:63,360) and sells for $1.50. In addition, the Anchorage and College mining-information offices have mylar copies of this map with avalanche scars overprinted on them; they may be checked out and reproduced at the requester's expense.

The Department of Natural Resources 1977 annual report was recently completed. The activities and highlights of the various DNR divisions are covered in the free 72-page publication.

Information circular 7, "Alaskan companies and prospectors - 1978," is out. This 37-page list of mining entrepreneurs is also free.

Earthquake Lights in Alaska: A Summary of the Evidence

By William Wagner, Light Engineering Associates, Hoptacong, NJ

Since the dawn of recorded history, man has been witness to one of Nature's most elusive and least understood phenomenon: Earthquake Lights, known to researchers as 'EQL.' Oriental legends dating back centuries mention this enigmatic luminescence. An old Japanese haiku, first quoted by Powell and Finkelstein,[1] states:

The earth speaks softly
To the mountain
Which trembles
And lights the sky.

EQL is generally described as bright, luminescent, multicolored sky glows that take place before, during, and immediately after earthquake activity. Until recently, science has taken a skeptical view of EQL—as well as it should—because 1) known observations are sporadic, 2) few trained observers have seen the lights, and 3) EQL is difficult to scientifically record and quantify. Artificial light sources in today's world further complicate light-phenomenon reports. Nevertheless, observations of EQLs have been made for years and photographs of the phenomenon have been published.[2] Moreover, popular interest is rising because EQL offers an opportunity to predict earthquake activity.

Although published reports on EQL date back to 1906,[3] two Japanese seismologists collected 1,500 reports of luminescent phenomenon from several Japanese tremors, most notably the November 1930 Idu Peninsula earthquake, and were able to draw significant conclusions and interpretations about the phenomenon. According to Musya (1931),[4] "The observations were so abundant and so carefully made that we can no longer feel much doubt as to the reality of the phenomena and of their connection with the shock (earthquake)." However, doubt and disinterest remained in the scientific community until the late 1960s, when an unusual earthquake swarm near Matsushiro, Japan generated numerous EQL phenomena. Yutaka Yasui, a seismologist for the Kakioka Magnetic Observatory, made personal observations and studied 34 detailed accounts of luminous phenomena from the Matsushiro area, including 14 sketches and 10 photographs made by local residents. He concluded that 18 of 34 could not be explained by well-known lighting activity such as twilight, sheet lightning, zodiacal light, auroras, meteors, or other sources; the remaining 16 were not necessarily 'normal' phenomena, either.[5] Yasui later described light phenomena associated with earthquake activity at Santa Rosa, California in 1969.[6]

The appearance of lights that accompany earthquakes is not confined to Japan. Spectacular EQL activity occurred during the devastating 1976 T'angshan earthquake on mainland China; the luminescence covered several hundred square kilometers and was so bright that houses were lit up during the night as if it were broad daylight. Many other descriptions of lights seen near peaks and summits of highlands during tremors have been recorded in various parts of the world, including Hawaii, Taiwan, Alaska, scattered areas throughout the continental United States, and the Soviet Union.

Physical Characteristics

EQLs are generally described as bright luminescences based near ground level or broad sky glows that cover areas up to several square kilometers, sometimes many tens of square kilometers. Coloration varies from bright white and blues to reds and oranges; green is rare. Colors other than white or blue are believed to be due to atmospheric variations such as humidity, barometric pressure, pollutants, and cloud cover.

The main characteristics of EQL have been summarized by Yasui[6] and Derr[7] as:

1) Flashes of from 10 seconds to 10 minutes, with up to a dozen repetitions within a single EQL event.
2) Broad glows or 'search-light' beams: occasionally they are restricted to point sources such as luminescent spheres 50-100 cm in diameter, rarely up to 200 m in diameter.
3) Occurrences near mountain summits and areas of active faulting.
4) Occurrences in areas that have basements rich in silicia mineralogy (high normative quartz); the Matsushiro area is underlain by quartz diorite.
5) Frequent occurrences accompanying major weather fronts coincident with earthquake activity.
6) Absence of anomalies in magnetometer and spectroscope readings during EQL activity; however, a large decrease in the electric potential gradient was noted at Matsushiro.
7) Radio interference that generally follows EQL and is strongest in the 10-20 kHz range.
8) The presence of large atmospheric potential gradients and measurable increases in radon gas near mountain tops and along active fault zones.

EQL Mechanisms

The two most popular theories on the mechanism of EQL are: 1) violent low-level air oscillation due to tremor activity that sets up electrical imbalances in the air and 2) piezoelectric effects that occur when SiO_2-rich rock undergoes stress. The latter theory is plausible when one considers the preshock periods when EQL is seen. In addition, Powell and Finkelstein[1] have shown that earthquake stresses are sufficient to generate millions of volts in quartz-rich rock bodies of relatively small size. The first theory can only be considered when EQL is seen during the tremor. The possibility of electrostatic charges is interesting when incongruities in animal behavior before earthquakes are considered.[8]

A third, less-accepted theory advanced by McDonald[9] and Simpson[10] leads to the possible explanation that some earthquake luminosities are indeed auroras; a magnetic coupling between the solar plasma and the geomagnetic field could impose torque on the rotational velocity of the earth and actually induce both the earthquake and earthquake light.

Alaskan Observations

Over the years several observations of unexplained lights have been reported near Mt. Iliamna (60°02' N., 153°05' W.), a 10,016-ft-high dormant volcano in the Chigmit Mountains of southern Alaska. Two published accounts make mention of luminous phenomena in the area. Vincent Gaddis[11] reports, "Gleaming in the mountains rimming Lake Iliamna on the Alaska Peninsula are the Iliamna Lights. Occasionally personnel at the Iliamna air field are startled by a brillant glow estimated to be 40 miles distant." In a 'UFO' Journal, Helms[12] relates, "On the Alaska Peninsula lies Lake Iliamna surrounded by mountains. A brilliant glow is often seen in the mountains to the south and occasionally it is so bright that it can be observed at an airfield 45 miles away. The Alaskan Natives who live in the area call the light the work of 'chacyo' (ghosts) and no one else has a better explanation." Neither of these references, which cover wide ranges of unexplained phenomenon, provide on-the-ground sources for the observations, however.

In mid-January of 1978, a 'false sunrise' took place over the western side of Cook Inlet as viewed by residents of Homer, Alaska. Some described it as yellow-

to-orange sheet lightning that appeared several hours before actual sunrise. Another explanation has been advanced—the lightning was caused by offshore oil-rig gas flaring that was reflected off cloud cover.

About the same time, Anchorage-based bush pilot Sumner Putnam saw luminescent phenomena from Nondalton (59°58' N., 154°51' W.), about 80 km west of Mt. Iliamna. According to Putnam, "On January 16, 1978, I was living in Nondalton, Alaska, and as the darkness gathered, I saw a bright greenish-white flash of light, which coincided with a static burst on the CB radio....the flashes continued at 7- or 8-minute intervals for about 10 or 12 repetitions. The cloud cover was about 50 percent, with visibility of 40 miles or so, and there was pitch darkness during the last five repetitions. The flashes seemed to light up the tops of the clouds and all the land and mountains as far as the eye could see. There was no sound except the CB static bursts....The center of the lighted area seemed to be to the south, over the east end of Lake Iliamna near Mt. Iliamna, and I estimate the flashes illuminated an area of 50 miles in diameter."

Putnam further stated that a number of Nondalton residents also saw the lights and that the aurora borealis, a common illumination in Alaska's sky, can be ruled out as a possible explanation. The CB static bursts would suggest an atmospheric electrical disturbance; airplane pilots flying over the Mt. Iliamna region have reported difficulties in radio transmission in the past.

Geologically the Mt. Iliamna area is underlain by diorite and quartz diorite of Jurassic age, with normative quartz from selected samples ranging as high as 39 percent.[13] The Bruin Bay fault is a major thrust(?) fault system in south-central Alaska; it transects directly underneath Mt. Iliamna. There has been a great deal of seismic activity ringing Mt. Iliamna; in fact, seismologists refer to the area as the 'Iliamna cluster,' an area of extreme concentration of earthquake epicenters near Mt. Iliamna. Available evidence suggests that the earthquakes are low-energy (2.5-4.0 on the Richter scale) shallow tremors associated with the Alaska Peninsula volcanic arc. Although low-energy quakes are usually precursors to volcanic eruptions, Mt. Iliamna has been dormant for many years.[14]

Possible EQL phenomena recently occurred on Shemya Island (52°43' N., 174°07' E.), on the western edge of the Aleutian Chain. According to an Air Force release, on the evening of February 16, 1978, an earth tremor measuring 4.0-4.2 on the Richter scale "shook the Cobra Dane (radar) and other facilities on Shemya AFB. As the tremor occurred, some Shemya personnel ran from the buildings and thought they saw bright lights hovering over the island. A check of the Shemya radar verified that there were unidentified blips on the radar screen."[15] The Air Force later released the following conclusions: 1) the bright lights were actually planets that appeared to move because of clouds passing by and 2) the unidentified blips on the radar were due to high waves in the surrounding sea.

Shemya Island is underlain by Tertiary mafic volcanic rocks and is part of the seismically active Aleutian volcanic arc.

Summary

No definite conclusions can be reached concerning these Alaskan luminescent observations, for they suffer from the same problems that characterize other possible EQL phenomena: no detailed data, the absence of trained personnel observing EQLs, and no means of measuring and quantifying them. Nevertheless, the Lake Iliamna region and Shemya Island area should be considered for further study of atmospheric potential gradients, geomagnetic fluctuations, and close-range monitoring of seismic activity. The importance of precursory indicators of earthquakes is obvious. The possibility of stresses along a fault resulting in atmospheric potentials strong enough to create 'ionized' atmospheric conditions cannot be ignored.

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(Note—full bibliographies are available from the DGGS editor)

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Mountain Named for Former Commissioner of Mines

The U.S. Geological Survey Board on Geographic Names announced recently that a mountain in southeastern Alaska has been named for Benjamin D. Stewart, former Territorial Mine Inspector and Commissioner of Mines. Mount Stewart is 3,415 feet high and is located 5-1/2 miles southwest of Juneau at 58°16'05" N., 134°33'35" W. Stewart (1878-1967) was also a mayor of Juneau.

DGGS Hires Geological Assistant

Chad Price, 27, has joined the hydrology section of DGGS as a geological assistant. A native of the Midwest, Price has a B.A. and an M.A. from the University of Wyoming and has his doctoral thesis from the University of St. Andrews in Scotland 'half-written.' Chad's interests include photography, bicycling, mountaineering, and cross-country skiing. He is unmarried.

"We cheat like hell."—Father Vaughan Quinn, goalie on an all-priest hockey team.

Mining Claims Suffer Decline

The number of new claims filed during the past 3-month period dropped sharply from the previous quarter, from 6,666 to 2,314, but is still running ahead of last year's record-breaking pace. Only 1,646 new location notices were filed for the months March through May 1977.

A breakdown of claims filed by recording district is given below, along with that from the period December 1977 through February 1978, which was omitted from the last *Bulletin*.

Mar.-May		Dec.-Feb.	
Barrow	40	Barrow	5,081
Fairbanks	1,534	Fairbanks	990
Glenallen	4	Glenallen	7
Juneau	5	Haines	31
Ketchikan	43	Juneau	27
Kotzebue	39	Ketchikan	289
Manley Hot Springs	123	Kotzebue	5
Mt. McKinley	92	Manley Hot Springs	5
Nenana	13	Nenana	11
Nome	28	Nome	17
Palmer	15	Palmer	26
Rampart	17	Petersburg	20
Seward	26	Seward	17
Sitka	132	Talkeetna	113
Talkeetna	189	Valdez	27
Valdez	14		

Alaskan Glacier Producing More Icebergs

(from Dept. of Interior news release, May 8, 1978)

Despite record snowfall, Columbia Glacier continued to thin near its seaward end last summer, and produced the largest embayment in the icefront yet seen as well as many small icebergs in nearby shipping lanes, according to a recent U.S. Geological Survey report.

Dr. Mark F. Meier, chief of the USGS glaciology project and editor of the report at the Survey's Tacoma, Wash., office, said "Formation of the embayment was accelerated by several unusually large episodes of calving or breaking off of glacier ice in mid-August. As a result, large plumes of icebergs extended into Valdez Arm and Prince William Sound, causing nighttime tanker traffic to be halted for part of the month." Valdez Arm includes the major shipping lanes for tankers transporting oil from the southern terminal of the Trans-Alaska Pipeline at Port Valdez, Alaska.

"There is no evidence yet that Columbia Glacier has become unstable and begun a dramatic retreat," Meier said, "but last summer's experience indicates that the glacier needs to be watched closely."

The USGS Columbia Glacier Team has monitored the 425-square-mile ice mass since 1974 to assess its potential for rapid backward movement and production of icebergs. "If Columbia Glacier does begin an accelerated retreat," Meier said, "it could throw off large icebergs at a very rapid rate."

Meier said that Columbia Glacier is the only calving glacier in North America that has not yet retreated from its extended position of several thousand years ago.

"Although the tip of the glacier now rests on a moraine shoal in shallow water," Meier said, "much of the bulk of the glacier actually occupies a deep channel with a base up to 2,300 feet below sea level in places. The greatest danger is that the rate of breakup and retreat will increase drastically once the front of the glacier retreats from the shoal into the deeper water of the channel.

"Since 1975, officers on the Alaska Ferry have noted that iceberg discharge has been greater than normal," Meier said. "This observation was also borne out by our aerial photography of the terminus. We noted that the altitude of the ice surface near the terminus decreased by more than 30 feet (10 meters) from 1976 to 1977. This may mean that a drastic retreat is imminent.

"If huge icebergs do form" he said, "the water over the moraine where the glacier rests is so shallow that the larger icebergs will be unable to leave the embayment. At lowest low water, the depth is only 75 feet (23 meters). These large bergs would break up into smaller ones which could then escape."

The USGS team found no evidence that the moraine contained buried ice, which could melt and allow freer movement of future icebergs.

CEQ 'Penetrates Myths' of Mining Law of 1872

(Excerpted from Council of Environmental Quality's "Hard Rock Mining on the Public Land," by David Sheridan)

Environmental Safeguards

As already noted, the Congress has laid down some fairly specific policy guidelines in the Federal Land Policy and Management Act of 1976. But even if the Forest Service and BLM were fully enforcing their regulations, these guidelines could not be completely implemented because of unresolved conflicts with the Mining Law of 1872. Under the current claim-patent system, adequate environmental safeguards do not exist.

The fundamental flaw is that the land management agencies do not have clear-cut legal authority to require adequate environmental protection. They can require a notice of intent, they can require an operating plan, but they cannot say no. Under the terms of the Mining Law of 1872, all lands in the public domain, unless withdrawn, are open to any citizen who is searching for hard rock minerals, and if that citizen locates a valuable mineral deposit, he has the right to develop it. This remains the main body of our hard rock mineral policy for the public domain. The new Forest Service and BLM regulations are satellites which orbit this body. For example, on Forest Service land in southeastern Utah near Price is a mountain ridge beneath which lies a high grade limestone deposit. A mining company has already

staked claims to the deposit. The limestone deposit runs across the whole ridge for several miles just below the surface, and as one Forest Service geologist put it: "The limestone holds the top of the mountain together."[101] Mine that deposit and the environmental consequences would be severe and probably irreversible—erosion will cause siltation of surface waters below the mountain, and removal of the limestone will destroy the aquifer system of the area. The Forest Service can require the mining company to file a notice of intent and a plan of operations; it can seek to minimize the damage by persuading the company to make certain precautions part of its operating plan. Still, great environmental damage will be done; it is unavoidable. The Forest Service cannot say to that company, "You cannot mine that deposit" because the company, under the Law, has a right to mine its claims.

On a somewhat less dramatic level, the Forest Service regulations are notably silent on what to do if a mining company refuses to accept modifications in its plan of operations which are proposed by the Forest Service and goes ahead with its exploration or mining as planned. Can the Forest Service compel a mining company to change its plan of operations? In the absence of any specific court decisions on this issue, the answer is probably not so long as the Mining Law of 1872 is in effect in its present form. Nor do the regulations provide for any kind of penalties. Until they do, many argue that it will be very difficult to achieve a higher rate of compliance. For example, a rancher who strays onto the public's land with a bulldozer while building a road for himself can be fined and/or imprisoned. A prospector who clears all of the vegetation away for a half-acre area and then levels it for drilling or cuts a new road across a mountainside without complying with the regulations is ordered not to do it again, but he is not fined and/or imprisoned.

Similar shortcomings—lack of sufficient authority and of penalties—are anticipated with the BLM regulations.

Spokesmen for the mining industry have argued that federal environmental safeguards are not necessary because the states are doing the job.[102] Indeed, most western states, with the notably exceptions of Arizona and Nevada, do now have mining reclamation laws. The new Colorado Mined Land Reclamation Act is often cited as an example "of the gravity with which the western states are presently approaching the subject of mined land reclamation."[103] This Act requires the filing of a notice of intent before exploration activities can be conducted. The notice of intent must be accompanied by a bond securing the reclamation of disturbed surface lands. In addition, the Act requires the issuance of a state permit before mining can take place. Before the mining permit is issued, the applicant's reclamation plan must be approved by the state, and the applicant must post a reclamation bond in an amount set by the state.

Unfortunately industry's view fails to take into account the reality of the situation as it was described by the National Academy of Sciences:

Most state laws governing surface mining and rehabilitation in the West do not provide for adequate planning, monitoring, enforcements, and financing of rehabilitation. State agencies charged with enforcement are generally understaffed which impairs implementation of the intent of the law.[104]

BLM and Forest Service personnel corroborate this view. In general, the western state agencies charged with enforcing environmental regulations for miners are understaffed and underfunded.

Besides, there is more to environmental safeguards than rehabilitation. Toxic and radioactive materials from mining and milling operations can pollute water systems as well as the air (i.e., through windblown dust from tailings dumps). Hence, ongoing controls of active mining operations are also vitally important.

Public Ownership

The current claim-patent system is indeed a last vestige of a former national policy. It is no longer the policy of the United States to dispose of the public domain for the development of agriculture, railroads, or the timber industry as it once was. Why should the government continue to dispose of public domain lands to promote mining? The Congress has declared it the policy of the United States that

the public lands be retained in Federal ownership, unless as a result of the land use planning procedure provided for in this Act (the Federal Land Policy and Management Act), it is determined that disposal of a particular parcel will serve the national interest....[105]

No objective reason exists for mining to continue to be an exception to this rule. Adequate incentives can be provided in other ways for finding and developing hard rock minerals on the public domain without relinquishing public ownership.

D-2 Impact on 7 Mineral Deposits Evaluated

(from Alaska Construction & Oil, May 1978)

A study done by Stanford Research Institute found that H.R. 39's impact on seven major mineral deposits in Alaska would be considerable. Some of the deposits are located on private land but all of the proposed mines are affected by the legislation because the transportation routes to market would pass through lands proposed for withdrawal. The seven mining proposals chosen for the analysis were those which have been most recently and most thoroughly explored. The deposits studied were Greens Creek, a lead, zinc, copper deposit on Admiralty Island; Quartz Hill, a molybdenum deposit near Ketchikan, Eagle Asbestos, an asbestos deposit located about 42 miles west and south of Eagle; Bohemia Basin, a nickel and copper deposit on Chichagof Island; Arctic,

*A copy of the references, which were too lengthy to print here, may be obtained by writing Editor, DGGS (College).

a copper, lead, zinc, silver and gold deposit on the southern flank of the Brooks Mountain Range east of Kotzebue; Picnic Creek (a deposit close to and similar to Arctic and Lik), a lead, zinc and silver deposit on the west flank of the Brooks Range north of Kotzebue. The study concluded that without d-2 impact, all seven mines could be operating by the 1990s, providing the nation with almost $1 billion worth of metals, 20,000 and 40,000 additional jobs and reducing the nation's balance of payments deficit by almost $1 billion. Benefits to Alaska in direct expenditures were estimated at $76.4 million for construction, $504.4 million for mining and $72.5 million for transportation. Full-time equivalent jobs which would be provided within the state were estimated at 1,538 in construction, 7,501 in mining, and 2,010 in transportation.

The Prince of Wales Island Copper Mining Industry, 1900-41

By Thomas K. Bundtzen, DGGS geologist

Before World War II, gold dominated southeastern Alaska's mineral industry but copper was 'king' on Prince of Wales Island. High-grade copper ores were discovered by the Russians on the Kasaan peninsula in 1865 but no major developments took place until 1900, when commercially viable deposits were located and developed.[1] In the next 4 decades, at least 19 mines produced high-grade copper ores containing appreciable precious metals; most of the ore was shipped to West Coast smelters. The island accounted for about two-thirds of Alaska's total copper production until 1911, when the great Kennecott mines in the Chitina valley and Prince William Sound began to dominate the industry. The two main sites of mining activity were the Kasaan peninsula and Hetta Inlet areas (fig. 1). During 1900-19, between 150 and 400 personnel were directly employed in the extractive and transportation segments of the mining operations.

The productive ore deposits can be placed into three major categories: 1) contact metasomatic magnetite-chalcopyrite (copper-iron) skarns and tactites containing significant amounts of molybdenum, silver, gold, zinc, and tungsten (the Jumbo mine on Hetta Inlet); 2) massive sulfide pyrite-chalcopyrite-sphalerite (copper-iron-zinc) 'shear zones' now regarded as stratiform deposits hosted in Precambrian and early Paleozoic orogenic piles (the Niblack, Khayyam-Mammoth group, and Copper City deposits)[2] and 3) sulfide-rich (bornite) pods and disseminations containing gold, silver, and platinum-group metals in mafic intrusive complexes (the Salt Chuck mine). Some deposits in the Kasaan peninsula area (Mount Andrews, Rich Hill, Rush and Brown mines) had characteristics of both 1) and 2) above and cannot be easily classified.[3]

During the early years the shear-zone deposits produced most of the ore. Later, the magnetite-chalcopyrite deposits on the Kasaan peninsula—particularly the Mount Andrews, Mamie, and Stevenstown mines—were developed (around 1906) and soon dominated the mining activities (table 1).[4] Two copper smelters were constructed and 'blown in' during 1905: a 400-ton/day plant at Hadley on the Kasaan peninsula and a 250-ton/day installation at Coppermount on Hetta Inlet. The smelters operated intermittently for 3 years, with the Hadley smelter producing the greatest amount of 'copper matte.' By 1908, however, both were closed because of declining ore quality, a falling copper market, and the difficulties in obtaining good coking coals.[5]

Production

The Rush and Brown mine at the head of Kasaan Bay, although plagued with metallurgical problems, was a fairly regular producer from 1904-1923. The It mine began operations in 1908 and continued until 1919. Beginning in 1907 the Jumbo mine on Hetta Inlet shipped ore to a Tacoma smelter for 13 consecutive years; this was the largest single producer (in metals) in the district, yielding 10,194,264 lb copper, 7,076 oz gold, and 87,778 oz silver from 122,937 tons of ore.[6] Other mines besides those previously mentioned include Haida, Poorman, Uncle Sam, Rich Hill, Copper Mountain, Houghton, Corbin, and Alarm deposits, all of which managed to make modest shipments of ore before 1930. The Salt Chuck (or Goodro) deposit was selectively

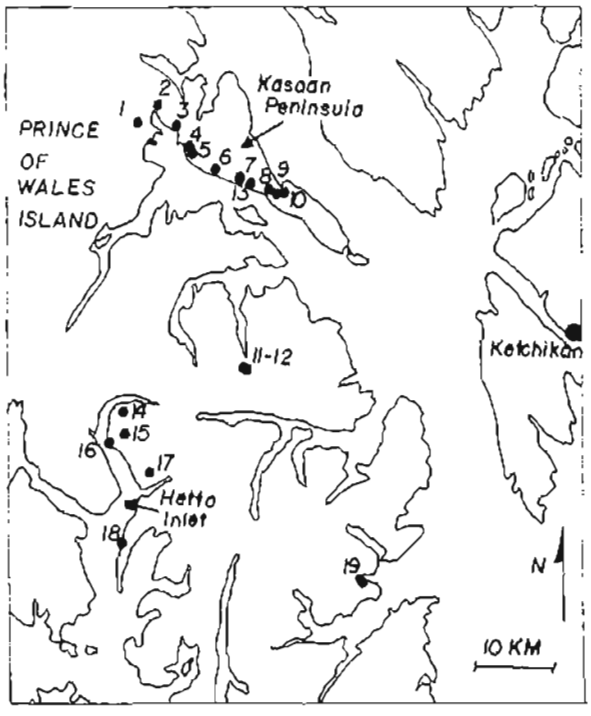

Fig. 1. Productive copper mines on Prince of Wales Island, 1900-41. 1 - Rush and Brown; 2 - Salt Chuck (Goodro); 3 - Haida; 4 - Alarm; 5 - It; 6 - Poor Man; 7 - Uncle Sam; 8 - Mt. Andrew; 9 - Stevenstown; 10 - Mamie; 11, 12 - Khayyam-Mammoth group; 13 - Rich Hill; 14 - Houghton; 15 - Jumbo; 16 - Corbin; 17 - Copper Mtn deposits; 18 - Copper City (Red Wing); 19 - Niblack Anchorage.

Table 1. *Production of copper mines on Prince of Wales Island, 1900-41*

Year	Price per pound ($)	Ore (tons)	Producing mines[1]	Copper produced (lb)	Copper value ($)	Gold produced (oz)	Gold value ($)	Silver produced (oz)	Silver value ($)
1900-04	0.120	25,000	8	1,600,000	192,000	...[3]	...	...	...
1905	0.157	30,400	8	1,901,392	295,616	1,178	34,370	13,000	7,867
1906	0.192	85,139	10	4,350,571	838,660	3,031	62,851	27,152	18,102
1907	0.200	79,982	10	4,760,000	951,761	3,384	69,960	44,196	29,143
1908	0.132	48,700	5	3,937,700	519,776	2,806	58,000	39,622	21,000
1909	0.129	28,491	4	2,705,988	351,000	1,946	40,028	16,679	8,641
1910	0.127	27,425	4	2,254,000	286,320	1,503	31,081	14,598	7,884
1911	0.123	13,735	3	977,468	120,719	613	12,678	6,573	3,484
1912	0.164	13,494	3	1,234,888	203,756	1,080	22,335	10,035	6,171
1913	0.186	7,276	2	599,903	92,985	484	10,000	4,447	2,686
1914	0.160	6,596[4]	2	468,660[4]	74,985[4]	449[4]	9,280[4]	4,122[4]	2,061[4]
1915	0.175	50,406	6	1,728,000	302,000	1,321	27,326	10,326	5,545
1916	0.246	76,111	7	3,526,703	867,569	2,769	57,000	19,000	12,640
1917	0.273	41,700	6	2,643,543	721,886	2,545	52,600	20,200	16,658
1918	0.247	21,683	7	1,372,347	338,970	1,364	28,207	9,746	9,745
1919	0.190	8,936	3	629,000	117,013	674	13,935	5,261	5,892
1920	0.183	16,088	2	670,155	123,308	812	18,868	5,313	5,791
1921	0.128	7,000	1	450,000	57,600	...	...	...	...
1922	0.134	6,500	1	422,500	56,615	...	...	...	...
1923	0.147	11,200	2	672,000	98,784	271[4]	5,601[4]	3,691[4]	3,691[4]
1924-26	0.137	289,000[5]	1[5]	5,433,200[5]	622,644[5]	7,745[5]	191,523[5]	29,044[5]	20,137[5]
1928	0.165	...[3]	...[3]	...[3]	...[3]	...[3]	...[3]	...[3]	...[3]
1936-41	0.105	...[3]	...[3]	...[3]	...[3]	...[3]	...[3]	...[3]	...[3]
Total		892,862		42,338,018	7,233,967	34,075	745,643	283,004	187,138

[1]Does not include mines with less than 1,000 tons production (in ore).
[2]Prices of precious metals have varied through the years. Gold was worth $20.67/oz until 1934, when it rose to $35/oz; during 1900-41 the price of silver varied from $0.38 to $1.08/oz, but usually stayed below $1.00.
[3]No data.
[4]Jumbo mine production only.
[5]Estimated from incomplete production records of the Salt Chuck copper-palladium mine.

mined as a copper deposit from 1908 until 1918, when the presence of platinum-group metals was detected in the ores. This stimulated production as a precious metal-copper-palladium mine until 1941.[7]

Except for the Salt Chuck, the overall grade of all the deposits mined on Prince of Wales Island was about 3.1 percent copper, 0.038 oz/ton gold, and 0.316 oz/ton silver. The Kasaan peninsula deposits yielded lowest grades, ranging from 2.13 (Mt. Andrew-Mamie) to 3.99 (It) percent copper, mostly skewed toward the former value. The Jumbo mine averaged 4.14 percent copper, 0.057 oz/ton gold, and 0.714 oz/ton silver, the best of the major operations. Precious metals, mainly gold, provided for 10-12 percent of the value of the ores. The average grade of 325,000 tons of ore from the Salt Chuck mine has been estimated at 0.94 percent copper, 0.04 oz/ton gold, 0.15 oz/ton silver, and 0.065 oz/ton palladium (although the first 10,000 tons mined averaged 4.0 percent copper, 0.10 oz/ton gold, and 0.60 oz/ton silver).[8]

History

Mining activity fluctuated with supply and demand of world markets. From 1904-07 the price of copper rose from 12 cents per pound to 20, and major production from the Kasaan peninsula deposits began. During this time, 10 mines produced ore on a fairly continuous basis throughout the entire district. Then, copper fell from 20 to 12.8 cents per pound in 1908 and mining was drastically curtailed. According to Knopf (1910, p. 140), "The financial depression of 1907 and severe fall in price of metals dealt a heavy blow to the copper mining industry of southeastern Alaska."[9]

Between 1908 and 1914 only small high-grade shipments were made from the Kasaan deposits. Some ores were shipped from the shear-zone deposits on Hetta Inlet. The Jumbo mine, because of its good ore grade and efficient management, continued to ship ore and 'toed the line' of the industry during these hard times. With the beginning of 'The Great War' in 1914, the price of copper began a dramatic rise, reaching 27.4 cents per pound in 1917. According to Chapin (1916, p. 83), "The copper production (in 1914) was an enormous increase over that of 1913 in natural response to intense demand and high price."[10] This revival lasted through 1918, and six or seven mines were in full operation. Again the Kasaan peninsula dominated production.

When hostilities ceased, production slipped dramatically and never recovered. Copper prices remained relatively high until 1920, but inflation, material and labor shortages created by the war, and exhaustion of good grades of ore in some of the mines caused a permanent decline in the district's copper-mining industry. By 1919 only two mines were operating: the 'old dependable' Rush and Brown, which managed to make shipments until 1923, and the Salt Chuck, which by then was a recognized platinum-group metal resource and was being mined for that commodity.[11] During the 1920s and 1930s, low prices of copper inhibited

mining interest. After 1923 the Salt Chuck deposit was mined as a precious metal-palladium mine with copper essentially recovered as a by-product in the periods 1924-26 and 1935-41.[8] Some ore was recovered from the Rich Hill deposit in 1928.

During World War II the magnetite-chalcopyrite deposits of Prince of Wales Island were regarded as possible sources of iron by the burgeoning defense plants in the Pacific Northwest. Detailed studies, including diamond drilling, of several of the larger known deposits were initiated by the U.S. Geological Survey and the Bureau of Mines. Reserves of 5 million tons of magnetite ores averaging 50 percent iron and 1.5 million tons of copper ores averaging somewhat less than 2 percent copper were proven by exploration, but no production to date has resulted from this work.[3]

Summary

The success or failure of these early copper mines, like any resource industry, depended on the favorability of the price of the commodities involved, inflation, availability of manpower and materials, ore metallurgy, and other complex economic factors. Although the largest mines of this area are considered small today, they nevertheless played a significant role in the early economic development of southeastern Alaska.

Minerals currently explored for in Southeastern include molybdenum, uranium, iron; base and precious metals, and industrial commodities. On Prince of Wales Island some interest continues in the known metallic reserves within the tactites and skarns, and the old shear-zone deposits are being reevaluated in light of new theories, including the massive sulfide-volcanogenic model, which has become an attractive and fashionable exploration target.

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Ed. note—Tom Bundtzen has become quite prolific lately. In addition to having a photo of a caribou herd published in the May issue of ALASKA magazine, he has published a colorful article in the spring issue of the Alaska Journal, "A history of mining in the Kantishna Hills."

The three most famous lies in the world: 1)"Sure, Honey, I'll marry you," 2)"The check is in the mail," and 3)"I'm a government worker and I'm here to help you."

Equator Rocks May Have Helped Form Alaska—USGS

(from Alaska Magazine, May 1978)

A unique "layer cake" of rock in the Wrangell Mountains has helped form the basis of a theory by the U.S. Geological Survey that a 40,000-square-mile block of land may have drifted thousands of miles from a point near the equator to form parts of Alaska, Canada and the Pacific Northwest. The northward migration is thought to have taken place within the last 200 million years and may have occurred over a 100-million-year period.

Tom Miller of the U.S.G.S. told the Associated Press that because much of the evidence for this land movement was found in the Wrangell Mountains, scientists have dubbed the slab of land "Wrangellia." Other sections of Wrangellia have been found on Vancouver Island, the Queen Charlotte Islands and in portions of Oregon, Washington and Idaho.

The rocks of Wrangellia form a distinct sequence in comparison to adjacent rocks. The sequence consists of a thick stack of lava flows, some of which apparently formed under water. On top of the lava is fossiliferous limestone and underneath is limestone shale and other volcanic rocks. The fossils are from organisms found in warm tropical climates. Other evidence of a northward magnetism that has remained in the rocks since their formation.

USGS Publishes New 'Topo' Map Index for Alaska

(Excerpted from USGS news release, Apr. 11, 1978)

A new index showing 2491 topographic maps covering most of Alaska is now available from the U.S. Geological Survey.

By showing the shape and elevation of the terrain and delineating in detail a wide range of natural and man-made features, the standard USGS topographic quadrangle map is a valuable record of the land surface available for use by engineers, scientists, planners, and others concerned with the Nation's resources and serves as a 'silent guide' for outdoor enthusiasts.

The map index includes 9 pages of text and a map of the state showing the extent of published topographic map coverage available for purchase. The index notes that about 1 percent of the state has been covered by 7.5-minute quadrangle maps at a scale of 1:24,000 (see p. 17). An additional 83 percent of the state is covered by 15-minute quadrangle maps at a scale of 1:63,360.

Copies of the Index to Topographic Maps of Alaska are available free from the Branch of Distribution, U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225.

Use your head. It's the little things in life that count.

Uranium Production Rises

Uranium-concentrate production increased in 1977, according to the Department of Energy. An increase of 2,200 tons of U_3O_8 was recorded last year, bringing the annual production total to 14,900 tons. Exploration and development drilling also increased last year—to 41 million feet, an increase of 7 million feet over 1976. The most two productive states were New Mexico, with 4.2 million tons of ore processed, and Wyoming, with 3.7 million tons. The average U_3O_8 content of the ore processed was 0.15 percent and the recovery of uranium from ore was 92 percent.

There was no uranium production in Alaska last year, but between $10 and $15 million was spent in exploration, chiefly in Southeastern and south of Fairbanks, said DGGS mining engineer Cleland Conwell.

AAPG on Land Withdrawal

(from Geotimes, April, 1978)

With Congress proposing to withdraw millions of acres of federal lands in Alaska from the possibility of minerals exploration and development (HR 39, Alaska National Interest Lands), the executive committee of the American Association of Petroleum Geologists has issued a statement opposing the land-withdrawal program as a whole. The committee points out that 'much of the country's most highly prospective areas for oil, gas, and other mineral production exist on federal lands.' It recommends that 'governmental processes should be expedited whereby all federally controlled areas, offshore and onshore, be made available for judicious energy mineral resource exploration and development.'

Adding to the committee's statement, AAPG's president, Edd R. Turner, charged that federal land-management programs as they exist today 'are archaic, inefficient and detrimental to private-sector efforts to resolve the energy crisis.' The federal government has 23 departments and agencies administering 112 land-oriented programs. 'The assurance of reasonable access to the surface of federal lands is essential to exploration for energy minerals,' Turner says. He adds that land restrictions affect not only the coal and petroleum industries, but also mining, forestry, farming, grazing, real estate, and recreation; of the 877 x 10^6 acres already designated as federal lands, 546 x 10^6 (62%) are effectively closed to exploration and development of energy minerals. Permits to drill wells on leased lands are rarely issued in less than 90 days, and leasing of federal lands in some western states has been delayed for years, pending environmental-impact statements.

The Alaska lands bill would designate 84 x 10^6 acres as 'wilderness,' thereby closing the areas to mineral, forestry, and agricultural activity. According to Turner, 'many of the areas are so remote that they stand for most part in frozen, pristine isolation.' The lands have not had a mineral assessment, and none is planned.

1978 DGGS Aeromagnetic Survey Being Flown by Geometrics

by Steve W. Hackett, DGGS Geophysicist

DGGS recently awarded a contract to Geometrics of Sunnyvale, California to fly more than 12,500 line miles to digitally record and process aeromagnetic data in northern Alaska. This regional geophysical program is jointly funded by DGGS and the U.S. Geological Survey. The aeromagnetic survey to be flown this summer will fill in a regional data void in the central Brooks Range (fig. 1).

The Survey Pass A1-D1; Wiseman A4-A6, B2-B6, C2-C6, D2-D6; Bettles C4-C6, D4-D6; Shungnak C1; and Hughes C1-C6 quadrangles will be flown by north-south traverse lines, spaced 3-4 mile apart with east-west tie lines for 15' tiers of each 1:63,360 quadrangle. The newly acquired aeromagnetic information will be used to tie together previously flown areas to both the east (by the USGS) and west (DGGS). The results of the 1:63,360 survey are scheduled to be released in the first half of 1979.

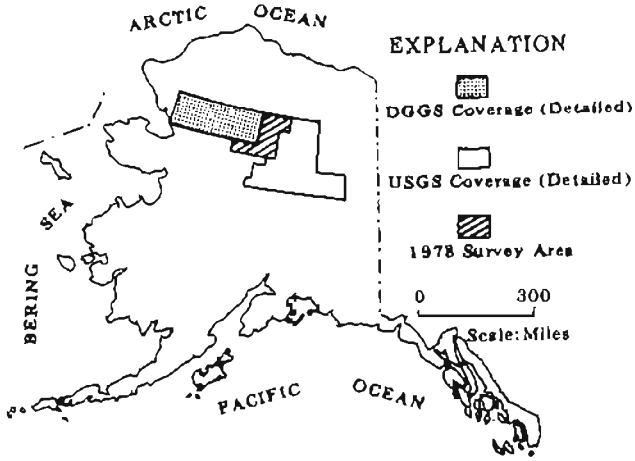

Fig. 1. Aeromagnetic coverage, Brooks Range.

DGGS' Hackett Selected for Unique Program

DGGS geophysicist Steve Hackett will leave for Moscow July 1 to participate in a USA-USSR Mountaineering and cultural exchange program. Hackett, one of six American mountaineers selected for the exchange program between the American Alpine Club and the Soviet Federation of Mountaineering, will take a 2-month leave of absence to climb and visit USSR's highest peaks.

Included in the itinerary are Peak Kommunism (24,590 ft), located in the central Pamir Range, and Pobedi Peak (24,406 ft), a mountain in the north-central Himalayas. In the latter area, near the USSR-China border, his team will explore and attempt several unconquered peaks in the Tien Shan Range.

Time permitting, the group will also journey to the Caucasus Mountains, between the Black and Caspian

Seas, to visit Mt. Elbrus, the highest peak in eastern Europe (18,510 ft).

In 1977, the Russian exchange team visited Alaska and climbed Mount McKinley.

Mineral Resource Potential of Mt. McKinley Region Appraised

(from Dept. of Interior news release, May 19, 1978)

The mineral potential of 7.2 million acres surrounding Mt. McKinley National Park is appraised in a report just placed on open file by the Bureau of Mines.

The appraisal was made under a $200,000 Bureau contract by C.C. Hawley and Associates, Inc., an Anchorage consulting firm. The total area described in the report is slightly more than 9 million acres and includes the park itself, which was evaluated solely on the basis of existing data. For the area around the park, existing data were supplemented by field studies that were intensive, but highly selective, because of the time and funds available.

The total area covered by the Hawley appraisal includes all main proposals for additions to the existing 1.9 million acre Mt. McKinley National Park. The Administration's proposal, one of the several now before the Congress, would add approximately 3.8 million acres to the existing park. These additions would protect vital mammal habitat to the north of the park and would also include on the south large portions of Mt. McKinley itself. Mt. McKinley, America's tallest mountain at 20,320 feet, is bisected by the Park's current southern boundary.

According to the report, "The Mt. McKinley region is significantly mineralized" with a variety of metallic and nonmetallic minerals and potentially commercially valuable coal deposits which are inside the study area but mostly outside the lands being proposed for addition to the park. The Bureau noted, however, that determination of the overall commercial significance of the study area was beyond the limits of the study, which was intended only as a general overview.

The Hawley report, entitled "Mineral Appraisal of Lands Adjacent to Mt. McKinley National Park, Alaska," is on open file at Bureau of Mines offices in Juneau, Anchorage (2221 E. Northern Lights Blvd.), and Fairbanks (UA Resources Building).

Arctic National Wildlife Range's Oil and Gas Potential Reappraised

(Excerpted from Dept. of Interior news release, May 23, 1978)

The Arctic National Wildlife Range (ANWR) in northeast Alaska could contain some medium to large oil and gas reservoirs, but is unlikely to hold a 'supergiant' accumulation such as Prudhoe Bay, Secretary of the Interior Cecil D. Andrus said today.

Under proposals now before Congress and recommended by the Administration, the huge wildlife range would be designated a wilderness area and expanded into additional territory considered to have low oil and gas potential—the areas away from the Arctic coastal plain.

Andrus said the remote region's spectacular but vulnerable wildlife resources outweigh the possibility that significant amounts of oil and gas exist there in commercially attractive concentrations. "Oil and gas are finite and rapidly expended. The ANWR and its existing surface resources can go on for many centuries if they are not disrupted. They are part of our national heritage and belong to future generations, not just to our own. Mineral development and transportation could severely damage this frail tundra and the thin but invaluable web of life it supports; once gone, it may never recover," Andrus said.

Andrus' comments accompanied the issuance of a report by the U.S. Geological Survey, which concluded that the ANWR is more likely to have a number of 'medium to large oil and gas accumulations than a 'supergiant' one, as previously available data, considered alone, seemed to suggest,' in the words of the report.

The ANWR, established in December 1960, contains about 8.9 million acres, and is located in the extreme northeastern part of Alaska. It is bound on the north by the Beaufort Sea; on the west by the Canning River; on the south by the Sheenjek River; and on the east by the Yukon Territory of Canada.

Although described as "substantial," the available data are considered to be "incomplete," according to the report; thus, while noting that the data establishes that the Arctic coastal plain is the only portion of ANWR with significant petroleum potential, the report notes that "the coastal plain contains relatively few exposures of the underlying geologic formations," and that "the geologic structure beneath the coastal plain is too complex to be adequately deciphered from the available outcrops."

The report speculates that Brookian rocks in ANWR have good potential for a number of moderate, and perhaps large, oil and gas deposits in Cretaceous-Cenozoic age (about 115 million years ago to the present) strata, but it is unlikely that supergiant fields will be found within them.

The report adds, "As a rough estimate... typical Brookian fields in ANWR might contain in the range of 10 to 200 million barrels of oil, and 0.1 to 5 trillion cubic feet of gas.

"In any case," the report concludes, "the geology of the ANWR coastal plain and adjacent areas permits the speculation that a number of Brookian fields could occur there, and available knowledge does not preclude the possibility that some of these might be very large."

Copies of the report, "Preliminary Analysis of Petroleum Potential of the Arctic National Wildlife Range, Alaska," by Arthur Grantz and C.G. Mull, published as Open-File Report No. 78-489, may be obtained from the USGS, Box 25425, Denver, CO 80225 for $11.25 each (paper copy) or $5 (microfiche).

U-Pb Zircon Age Dates Shed New Light on Brooks Range Deposits

Recent results of uranium-lead zircon age dating may have substantial economic significance, according to DGGS geologist John T. Dillon. The dates, obtained through a contract with the University of California at Santa Barbara, demonstrate that some large plutons in the central Brooks Range first crystallized about 340 million years ago. At about the same time, the volcanic rocks and associated ore deposits of the Ambler district and those in the Red Dog and Drenchwater areas were being extruded and deposited. If the plutonic rocks, the volcanic rocks, and the ore deposits came from the same source, the rocks in and near the plutons as well as contemporaneous strata may have high mineral potential.

The following is the text that Dillon and coauthor Wyatt G. Gilbert submitted in abstract to the Geological Society of America for their national meetings publication.

U-Pb zircon ages from metaigneous rocks in the south-central Brooks Range yield older ages for plutons formerly thought to be Cretaceous. Two Hadrynian plutons with associated paragneiss lie beneath Paleozoic metasedimentary rocks. Two Late Devonian-Early Mississippian (LD-EM) plutons intruded and metamorphosed penecontemporaneous sedimentary rocks. Two LD-EM volcanic units are now part of the southern Brooks Range schist belt and, together with Hadrynian blueschist K-Ar ages and LD-EM fossil ages from adjacent rocks, evince a lower Paleozoic unconformity near the Walker Lake lineament.

LD-EM schist belt metavolcanic rocks and adjacent syngenetic ore deposits parallel a belt of contemporaneous, stratiform ore, and volcaniclastic deposits in the northern Brooks Range. Between these belts are LD-EM plutons at Mt. Igikpak, Arrigetch Peaks, Wild Lake, and Chandalar. These three belts are probably comagmatic, suggesting the possibility for ore deposits in and near the metaplutonic rocks. The magmatic belts and Hadrynian basement rocks may extend to the west (Seward Peninsula), east (Romanzof Mountains), and south (Ruby Geanticline).

'North-dipping' (present-day) Hadrynian subduction may have produced blueschists and igneous rocks. LD-EM igneous rocks probably formed above another 'north-dipping' subduction zone during the Antler Orogeny. Coeval carbonate reefs (Skagit Fm.) fringed this magmatic arc and graded into fine-grained clastic facies to the north and south. Jurassic and Early Cretaceous magmatic rocks of the Selawik-Koyukuk lowlands formed above a south-dipping subduction zone, which obducted Mississippian through Permian ophiolite onto pre-Mesozoic rocks, causing the 130 ± m.y. Brooks Range metamorphism.

Furthermore, Dillon states that the apparent root zone for Brooks Range ophiolites is along the Kobuk Trench.[1] However, steeply dipping, gouge-marked Middle to Late Cretaceous faults there are not typical of deep-crustal, synmetamorphic thrust faults. Middle to Late Cretaceous isostatic rebound of the Brooks Range demonstrated by 1) Late Cretaceous K-Ar cooling ages within the range, 2) coarse Upper Cretaceous breccia and conglomerate derived from the range, and 3) the present orographic position of the lower plate rocks may have resulted in normal faulting along the Kobuk root zone. One hundred km of post-Early Cretaceous right separation along the eastern Kobuk Trench allows the additional speculation that the Kobuk Trench was the mid-Cretaceous continuation of the Tintina fault[2] prior to displacement by the 130-km Late Cretaceous or early Tertiary right slip documented for the Kaltag fault.[1]

REFERENCES

[1]Patton, W.W., Jr., and others, 1977, Preliminary report on ophiolites of northern and western Alaska, *in* North American ophiolites (R.G. Coleman and W.P. Irwin, eds.): Oregon Dept. Geology and Mineral Industries Bull. 95, 183 p.
[2]Grantz, Arthur, 1966, Strike-slip faults in Alaska: U.S. Geol. Survey open-file report.

'Directory of Permits' Issued

A Directory of Permits was recently published jointly by the Department of Commerce and Economic Development and the Department of Environmental Conservation. The publication includes a description of permits issued by state and federal agencies, permit requirements, and statutory authority. Addresses of agencies where permits can be obtained are also provided. An appendix includes an alphabetical list of permits and an index by subject. Nearly 600 permits are described in detail.

The directory, which is updated yearly, is currently published for governmental use only, but may be examined at any CED or DEC office and many other agencies as well. For further information, contact the Department of Commerce and Economic Development, Division of Economic Enterprise, Pouch EE, Juneau, AK 99811.

Federal Regs Clogging Copper Industry

(from Mining Activity Digest, Apr. 7, 1978)

According to a study by Arthur D. Little Inc. conducted for the Environmental Protection Agency (EPA), federal regulations to control air and water pollution are slowing the growth of the US copper industry, pushing up prices, forcing changes in technology, and probably reducing the industry's international competitiveness. (The study considered the effects of restrictions imposed only by The Clean Air Act amendments of 1970 and 1977, and the Water Pollution Control Act amendments of 1972). To meet air and water regulations the study estimates that the industry will have to spend $1.7-$1.9 billion (1974 dollar) in capital expenditures over the period 1974-1987. To date about one-third of that sum

has already been spent. Over the same period it is estimated that copper companies will spend $1 billion to operate and maintain pollution control equipment. The study projects that prices for primary refined copper will rise 23.3%-32.8% by 1985, and 29.4%-38.7% by 1987. The report also suggests that production will drop almost as steeply as prices will rise. By 1987, the decrease in output could range between 24.9%-32.9%.

They Said It....

"The open access to minerals on public lands is one of the few remaining vestiges of our former national policy."—Robert C. Anderson, economist, 1976.

"I'd hate to see the little guy driven out of the business of going out and looking for a mineral deposit and staking a claim."—Dahl Zohner, U.S. Forest Service.

"Except for extensive exploration by mining companies, hard-rock mining experienced little that was positive in 1977."—National Bank of Alaska 1977 annual report.

"And I'll admit I'm high on Alaska and I'm hooked."—Rep. John F. Seiberling.

Our Gangue....

By Frank Larson, DGGS editor

An American tragedy has occurred. 'Wood Eye' is dead. [The original Wood Eye, you may recall, was the Revolutionary War vet who lived the life of a recluse because he lost an eye in battle and his replacement eye, carved from a willow knot and adorned with a hand-painted iris, lacked what some might call verisimilitude. As a result, he hied for the woods. One night, however, he came out of his sylvan hovel to attend a ball at the local fort and, after a number of ales, bowed to the repeated urgings of a friend to ask a lonely (but shapely) young lady with a rather large proboscis to dance. He acquiesced, but not before vowing, "All right, I'll ask, but she had better not make fun of my eye." He approached the lass, bowed low, and murmured, "Would you care to dance?" Her face lit up at the prospect of her first dance of the evening and she exclaimed, "Would I? Would I?" Our Hero, stunned, pointed his finger at her and shouted, "Big Nose. Big Nose."]....But I digress. Wood Eye is dead. Wood Eye, you see, was the 1964 Detroit-model rust bucket with the 1/6-million miles on it, with the battered front end, with the rear seat overflowing with 'cripples,' and with a wooden grill. Yes, a wooden grill....You see, the old beater was the tragic victim of a hit-and-run one wintry evening. But my ingenious (when sober) friend Russ and I soon fooled the local critics, who crowed, "That crate'll never see the light of another saloon parking lot again." How? Simple---all it takes is a fine eye and some finite tools (a 4-by and a tow chain). We 'straightened out' Wood Eye's body and then ran jumper cables from the newly modified (i.e., more compact) engine compartment through the passenger's window to the new battery compartment (the floor of the front seat). As a crowning touch, the DGGS Dynamic Duo painstakingly applied some Old World cabinetmaking expertise and fashioned a grill from 2-by-4s and leftover paneling to hold in the headlights. The results?---A mobile art form, perhaps? Alaskan trash? The Old Oaken Bucket? (Maybe Mildred Brown hit it right when she called it a 'toilet'.) But I digress again....Wood Eye, the Faithful(?) Warrior of the Interior, has departed this vale of tears. I had no choice. He now reposes in the Home for the Automotive Aged ('junkyard' sounds so crass). You see, May 31 is my annual 'D-Day'---Decision Day, and every year I had to do some soul searching and ask, "Is Wood Eye worth another $30 license tag?"....Well, this year the poor fella failed the test.....Perhaps I should have put the touch on Sohio. They recently signed a 4-year $25-$30 million contract with Native-owned Petrolane-NANA to drill development wells at Prudhoe Bay. Included in the deal is a provision for the latter firm to build an $8.5-million drilling rig capable of operating under the most severe weather conditions.....In other developments, Husky Oil NPR Operations has completed a second producing gas well in the South Barrow gas field, 2 months after the first successful development well came in. The natural gas will be used for local energy needs (Barrow and several nearby federal installations).....Beacon Light Mining acquired a 3-year option to purchase seven uranium claims about 60 miles north of Fairbanks. ....Ambler Mining reported finding a mineralized area on its Brooks Range claims, located between the Ambler and Red Stone Rivers. One drill hole had 27.6 feet that assayed 2.9 oz silver, 8.8% zinc, and 2.6% lead; a drill hole 2,500 feet away had 10.5 feet that assayed 15.75 oz silver, 2.3% zinc, 1.2% lead, and 0.06 oz gold....The geologist has been ranked fifth of the 10 most promising professions, according to *Money* magazine. Rock smashers are preceded only by doctors, veterinarians, systems analysts, and dentists. Included in the 10 worst career opportunities for newcomers are teachers, clergymen, biologists, and lawyers....Perhaps local politicos should be included on one of these lists. The Anchorage Assembly approved the Turnagain slide area along Knik Arm for development—despite warnings it is unstable. This is the area that sank and destroyed part of a subdivision during the '64 quake. However, the location may be subject to further regulation, since it falls within a State coastal-zone-management region....Hey, USGS: Now that you've nearly completed your nearly 2-decade-long cooperative effort with the Kentucky state survey in mapping the Bluegrass State at a 1:24,000 scale, would you care to fund DGGS for a similar project? At the same rate, it would only take 290 years..... Wood Ewe? Wood Ewe?.....Cheers.

Metals Market

	May 15, 1978	Three Months Ago	Year Ago
Antimony ore, stu equivalent European ore	$ 16.20-18.20	$ 16.20-18.20	$ 23.50-25.00
Barite (drilling mud grade per ton)	$ 19-28	$ 19-28	$ 19-28
Beryllium ore, stu	$ 40-42	$ 40-42	$ 40-42
Chrome ore per long ton (Transvaal)	$ 54.00	$ 54-58	$ 56-61
Copper per lb. (MW-prod.)	$ 0.64	$ 0.62	$ 0.72
Gold per oz.	$173.99	$178.86	$147.31
Lead per lb.	$ 0.31	$ 0.33	$ 0.31
Mercury per 76-lb flask	$150.00	$159.00	$130.00
Molybdenum conc. per lb.	$ 4.41	$ 4.01	$ 3.45
Nickel per lb. (cathode)	$ 2.13	$ 2.06	$ 2.41
Platinum per oz.	$222.00	$232.50	$162.00
Silver, New York, per oz.	$ 5.05	$ 5.00	$ 4.74
Tin per lb., MW composite	$ 5.78	$ 5.88	$ 4.48
Titanium ore per ton (ilmenite)	$ 55.00	$ 55.00	$ 55.00
Tungsten per unit (GSA domestic)	$124.00	$130.00	$156.26
Uranium per lb., MW US spot oxide	$ 42.5-44	$ 42-44	$ 41-42
Zinc per lb. (MW US PW)	$ 0.29	$ 0.305	$ 0.34

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