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# GEOLOGY AND GEOCHEMISTRY NEAR WALKER LAKE, SOUTHERN SURVEY PASS QUADRANGLE, ARCTIC ALASKA (1972)

by

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## GEOLOGY AND GEOCHEMISTRY NEAR WALKER LAKE, SOUTHERN SURVEY PASS QUADRANGLE, ARCTIC ALASKA

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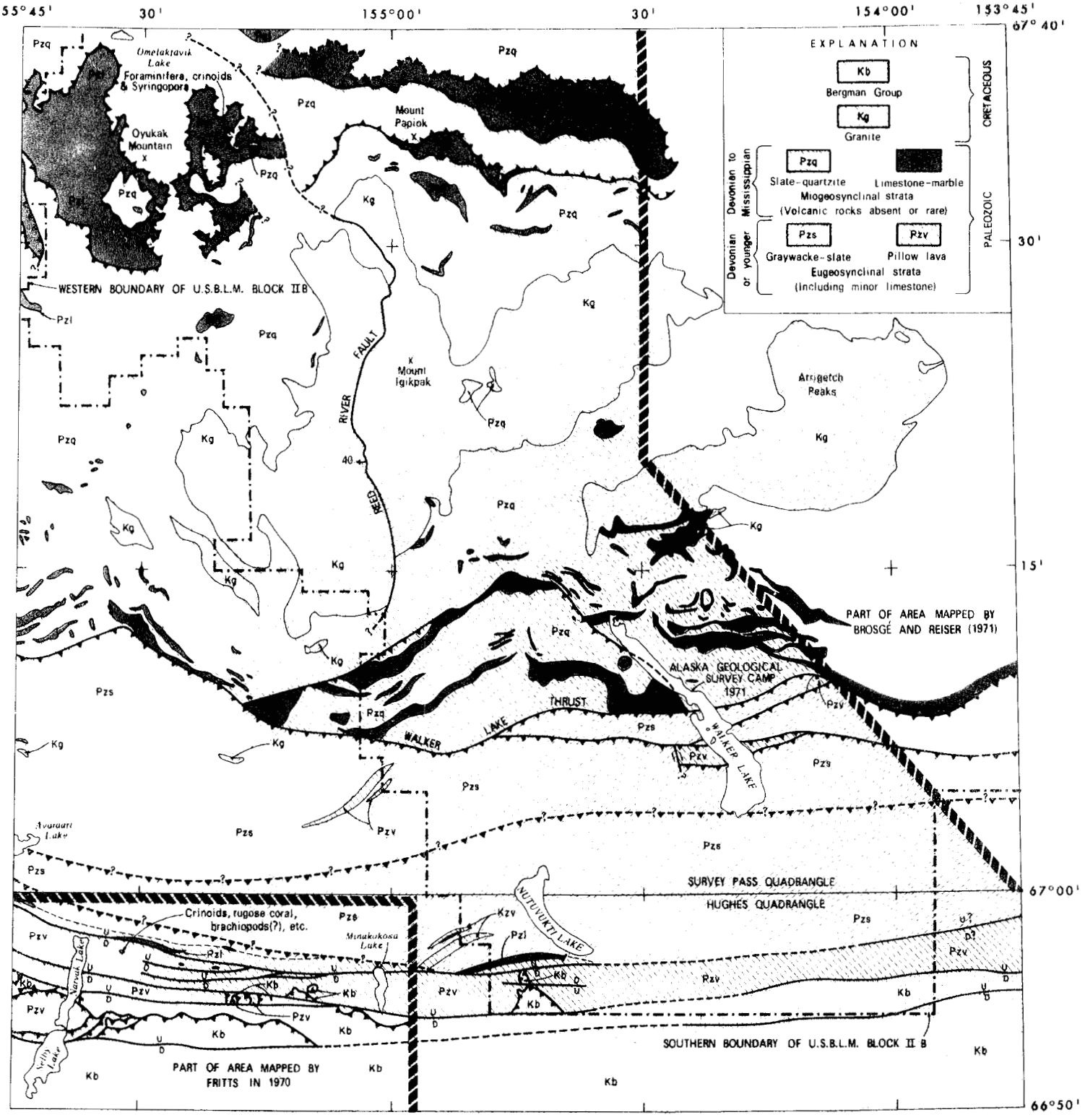
Geological mapping and geochemical stream-sediment sampling were undertaken in the summer of 1971 in the southern part of the Survey Pass quadrangle near Walker Lake (fig. 5) for two main reasons. (1) In 1968, the senior author had begun a long-term study of a broad, complexly deformed belt of copper-bearing metasedimentary and metavolcanic rocks along the southern flank of the Brooks Range, extending eastward from the Cosmos Hills through the Angayucham Mountains toward Walker Lake. Field work near Walker Lake in 1971 was a logical continuation of that project. (2) In late 1970, the U. S. Bureau of Land Management proposed a new classification of land in the central Brooks Range, which included some 2,600,000 acres in Block IIB, covering much of the Survey Pass quadrangle. That classification would have rendered Block IIB "...closed to mining and land actions that result in title transfer... [and] ...closed to selection by the State of Alaska." In view of the Division's long-term regional mapping program and a general lack of geological data concerning Block IIB, the State, via Senate Joint Resolution No. 19, dated February 2, 1971, requested that the land classification be postponed until the area was mapped in sufficient detail to permit a reasonable appraisal of its geology and economic potential. Subsequently the classification was postponed, and mapping commenced with full helicopter support.

The main base of operation in 1971 was a multi-tent camp established in late May on the east shore of Walker Lake near its narrowest point. Field work was accomplished from there with the aid of a Hiller 12E-4 helicopter under a contract won by Merric, Incorporated, of Fairbanks. Deep snow during the previous winter prevented the landing of large aircraft on lake ice before spring breakup, so helicopter fuel was shuttled to the camp via float plane from Bettles throughout the summer. Fuel also was cached on Omelaktavik and Avaraart Lakes in the northwestern and southwestern parts of the mapped area, respectively, to facilitate mapping there.

The field party consisted of three geologists, three (briefly four) assistants, a cook, and helicopter personnel. All of the geological personnel cooperated as much as possible in the accumulation of basic data, but responsibility for certain phases of the work was divided according to individual interests, training, and (or) experience. In this report, Fritts will concentrate on regional bedrock geology, including stratigraphy and structure, Eakins on geochemistry and economic geology, and Garland on surficial geology and archeology.

Mapping at scale 1:63,360 (1 mile = 1 inch) and stream-sediment sampling at practical intervals such as 1/2 to 1 mile were confined to the central and southwestern parts of the Survey Pass quadrangle, or more specifically to the southwestern third of Block IIB, which had not been studied previously. The field party attempted to tie into a recent geologic map of the Wiseman and eastern Survey Pass quadrangles compiled by W. P. Brosgé and H. N. Reiser (U. S. Geol. Survey open-file rept. 479). A total of approximately 1700 square miles were mapped, and 764 stream-sediment samples were collected during June, July and August.

The most significant geological discovery during the summer was the recognition of a major west-trending, high-angle, thrust fault, which passes beneath Walker Lake near its narrowest point. This fault, here called the Walker Lake thrust, was mapped for at least 65 miles along strike, and is believed to continue eastward at least another 15 miles. The fault was traced westward from Walker Lake more than

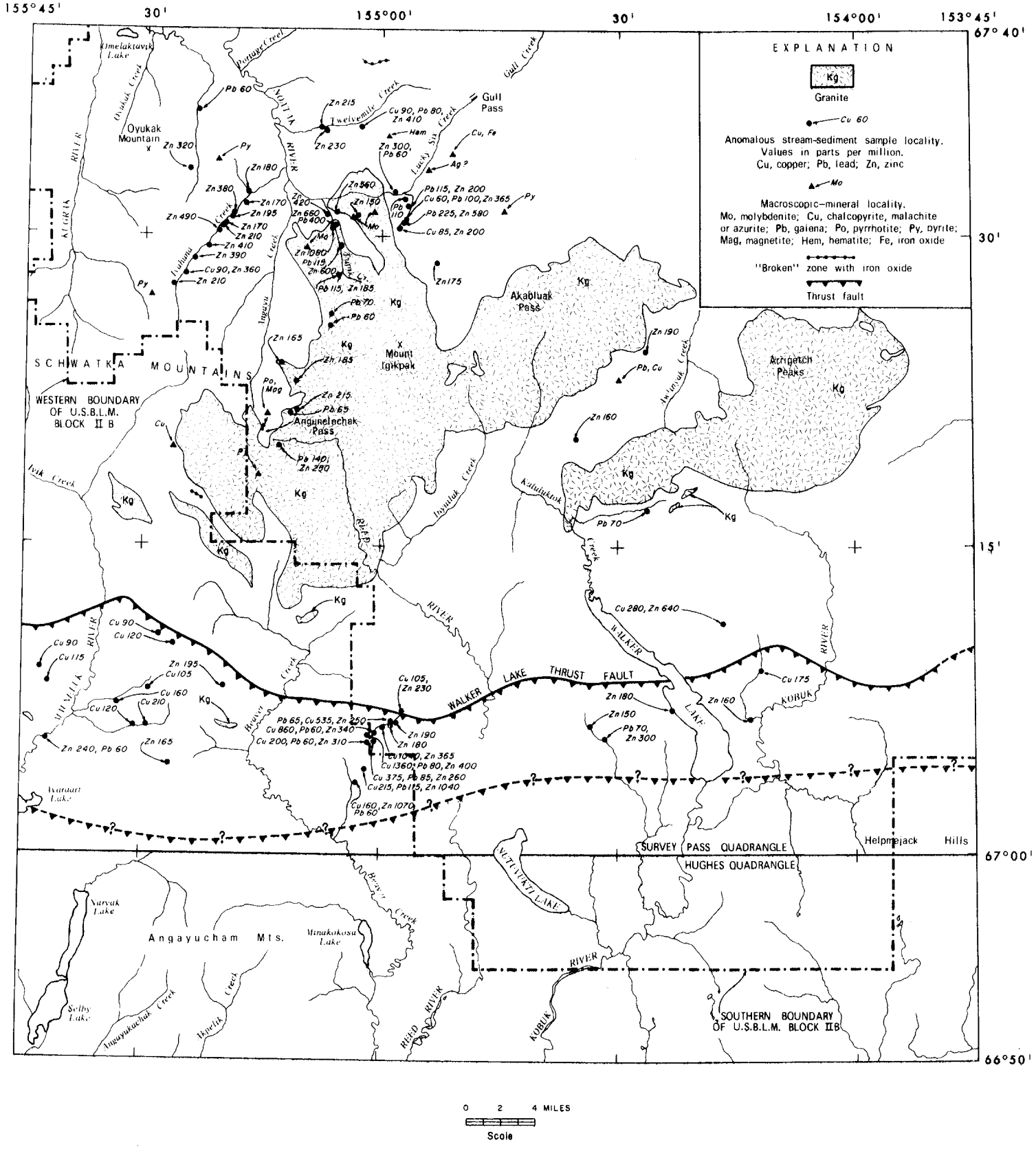



STRUCTURAL SYMBOLS FOLLOW CONVENTIONAL STANDARDS.

GEOLOGY MAPPED BY C. E. FRITTS, G. R. EAKINS AND R. E. GARLAND, ASSISTED BY J. T. LARSON, W. S. ROBERTS, J.M. ZDEPSKI AND G. L. KLINE.

**SIMPLIFIED BEDROCK GEOLOGIC MAP OF THE WALKER LAKE AREA, SURVEY PASS AND HUGHES QUADRANGLES, ARCTIC ALASKA, 1971**

**Figure 5**




**GEOCHEMICAL SAMPLING IN THE WALKER LAKE AREA, SURVEY PASS AND HUGHES QUADRANGLES, ARCTIC ALASKA, 1971**



**Figure 6**

50 miles to the Kogoluktuk River in the eastern Ambler River quadrangle. It is believed to cross the river at a point approximately 6 miles north of Bear Creek Mining Company's Arctic Camp prospect, which is 16 miles northeast of Bornite. The fault also was mapped at least 15 miles eastward from Walker Lake, and is believed to extend at least another 15 miles to the north end of Iniakuk Lake in the eastern Survey Pass quadrangle. It probably forms the southern boundary of the Skajit Limestone in the part of the Survey Pass quadrangle recently mapped by Brosgé and Reiser (idem.), although it is not shown by a fault symbol on that map. Displacement on this fault undoubtedly is many miles, as it completely cuts off a triangular fault block containing at least 5 to 6 miles of carbonate-rich strata of the Skajit type west of Walker Lake.

Throughout the 80-mile distance from the Kogoluktuk River to Iniakuk Lake, the Walker Lake thrust separates distinctly different geological terrains, and it appears to be the most important structural break in this part of the Brooks Range. The fault apparently constitutes a boundary along which two great plates containing rocks as old as Devonian collided in late Mesozoic to early Tertiary time. This caused (1) extreme tilting of the colliding strata in opposite directions, making northern strata dip north and southern strata dip south, (2) upward thrusting of the southern plate relative to the northern one, (3) local overturning of rocks in the northern plate as a result of upward and northward drag, (4) related high- and low-angle thrust faulting of strata within the northern plate, including the possibility of northward gravity sliding away from the Walker Lake thrust, and (5) extensive, imbricate, high-angle, thrust faulting of strata in the southern plate due to continued pressure from the south. Prominent high-angle normal faults, which cut thrust faults involving strata of Cretaceous age in the southern part of the area, are attributed to a post-thrust episode of relaxation in Tertiary time. The normal faults are characterized by minimum displacements of as much as 3,000 feet.

In this area, the southern plate consists mainly of thousands of feet of steeply inclined eugeosynclinal strata of possible Devonian age, including predominant graywacke-slate (and graywacke-schist), associated weakly metamorphosed pillow lava, and a little radiolarian(?) chert. Near the Walker Lake thrust, some of them contain glaucophane. Farther south, these rocks are overlain by conglomeratic continental strata of the Bergman Group of Cretaceous age, which presumably were derived from the ancestral Brooks Range as the older rocks in it were being deformed. Pillow lavas and chert are most abundant in the Angayucham Mountains, but also crop out near the southern end of Walker Lake and at other localities. Dips of 50° to 70°S are common, but some strata are nearly vertical or locally overturned. Tops of pillows and graded beds consistently face south. Scattered, discontinuous beds and lenses of crystalline limestone a few tens to a few hundreds of feet thick within these pelitic and volcanic strata contain rugose corals, especially in and near the Angayucham Mountains, indicating a probable Paleozoic age for the sequence. Known and inferred imbricate high-angle thrust faulting within the southern plate probably accounts, in part, for an enormous apparent thickness of the Paleozoic stratigraphic section there, which is 14 to 22 miles wide across strike. Structure is complicated further by the late large-scale normal faults shown near the southern edge of the map. Strata in this plate are intruded by at least two small plutons of well foliated and lineated syntectonic granite of Cretaceous age less than 2 miles in diameter, which are shown on the map north and northeast of Avaraart Lake.

In contrast, the northern plate contains thousands of feet of north-dipping, carbonate-rich and quartz-rich strata of the miogeosynclinal or stable-shelf type, including the Skajit and Lisburne Limestones and associated pelitic and quartzitic rocks. These strata are exposed in a belt at least 35 miles wide across strike, in

which dips generally flatten northward. Volcanic rocks are absent or rare. Tops in the northern strata commonly face north, although beds locally are overturned in Skajit-type limestone exposed near the Walker Lake thrust in the western part of the mapped area. Some of the youngest of the northern strata mapped in 1971 contain foraminifera of probable Mississippian age, which were identified by A. K. Armstrong, U. S. Geological Survey. These fossils were found about 5 miles east-northeast of Oyukak Mountain in a part of the area characterized by imbricate low-angle overthrust faults. The foraminifera (and associated crinoids and Syringopora) were in or near thin limestone beds within largely pelitic strata above (and surrounding) broad window-like areas of marble believed to represent parts of the Skajit Limestone. Similar marble also crops out in a thrust-bound lens near Mount Papiok. Lisburne(?) Limestone crops out near Gull Pass. The northern strata have been intruded by several large concordant to discordant plutons of well foliated and lineated syntectonic granite of Cretaceous age. The largest pluton is 20 to 30 miles in diameter and is well exposed in some of the highest peaks of the central Brooks Range, including 8510-foot Mount Igikpak. This pluton is cut by a large-scale, north-trending, west-dipping fault, here called the Reed River fault, which is shown on the map.

Geochemical stream-sediment samples collected during the summer were analyzed for trace amounts of copper, lead, and zinc by the atomic absorption method at the Division laboratory in College. Anomalous values for these metals were determined by inspection of frequency distribution histograms. Minimum anomalous values are as follows: 85 ppm copper, 60 ppm lead, and 160 ppm zinc.

Anomalies (fig. 6) are concentrated in four general areas, namely (1) a west-trending belt of graywacke-slate and related schist south of the Walker Lake thrust fault west of Walker Lake, (2) the northernmost margin of the major granite pluton in the area near the Reed River fault and the Noatak River, (3) Iyahuna Creek and Twelvemile Creek, tributaries of the Noatak west and north of the north end of the main pluton, and (4) the western margin of the main pluton near Angunelechak Pass. Only four isolated and scattered anomalies occur outside the above areas. One of these, located about 4 miles east of Walker Lake, is quite strong, showing 280 ppm copper and 640 ppm zinc. The others are weak and probably not significant.

Several strong copper-lead-zinc anomalies in the southern belt, approximately 18 miles west of the southern end of Walker Lake, were obtained from an area near Bear Creek Mining Company's Picnic Creek prospect. Stream sediments there yielded maximum values of 1360 ppm copper, 1070 ppm zinc, and 115 ppm lead. These copper and zinc values are the highest found and are in the same structural belt as Bear Creek's Arctic Camp prospect near Bornite.

Other copper-zinc anomalies in the southern belt of graywacke-slate and related schist are from scattered localities between Beaver Creek and the west side of Mauneluk River. These anomalies are weak to moderately high, showing as much as 210 ppm copper and 240 ppm zinc. Only one lead anomaly was found, showing a weak 60 ppm. While the copper and zinc values in this area offer some encouragement for prospecting, the distribution does not pinpoint any local concentrations, and no mineralization was observed in outcrop. The same comment can be made for anomalies from five other locations near the south end of Walker Lake.

Four localities along the western edge of the main pluton near Angunelechak Pass produced two anomalies for lead (65 and 140 ppm), and four for zinc (165 to 215 ppm). A north-trending "broken" zone, containing iron oxide staining and a few small pods of pyrrhotite less than one inch wide, extends for several hundred feet at Angunelechak Pass.

Summer field party working in the Walker Lake area of Survey Pass Quadrangle, Arctic Alaska.
Above, Jim Fritts and Bob Garland mapping near the Kugrak River.
Left, Al Kendall, helicopter pilot, and a 425-pound quartz crystal found 20 miles west of Walker Lake.
Bottom, Gil Eakins using field radio west of Gull Pass.

Figure 7

Lead and zinc anomalies were detected along two small streams which drain into the Noatak River near the northernmost part of the main pluton. One stream is Tupik Creek. The other is unnamed but is almost opposite the mouth of Lucky Six Creek. At Tupik Creek, zinc values ranged from 600 to 1080 ppm and lead from 115 to 400 ppm. At the unnamed creek, copper was 60 to 85 ppm, lead 100 to 225 ppm, and zinc 300 to 580 ppm.

Iron staining is visible in granite in bluffs on the north side of the Noatak River, and pyrite was found in the unnamed creek opposite Lucky Six Creek. Several patches of bright yellow iron staining as much as a few hundred feet wide are present in the region between Angayu Creek and Kugrak River to the west. Considerable pyrite also was found in a white quartzite in a tributary on the east side of the Kugrak River near its head.

Moderately high zinc anomalies were detected in sediment from Iyahuna Creek, which flows into the Noatak from the south about four miles west of the northernmost granite. Anomalous values were obtained along this stream for a distance of seven miles. Zinc values ranged from 170 to 490 ppm. A single copper anomaly there shows a low 90 ppm. No lead anomalies were found there. The copper and zinc anomalies, along with gossans, make the drainage of Iyahuna Creek an interesting area for prospecting.

Across the Noatak River from Iyahuna Creek, three anomalous samples were collected from Twelvemile Creek. These showed zinc values of 215, 230, and 410 ppm, respectively. One showed 90 ppm copper, and another 80 ppm lead. About two miles north of Twelvemile Creek, near its head, a west-trending, iron-stained "broken" zone in dolomite can be traced for almost two miles.

Sulfide minerals other than pyrite were observed at five localities. Molybdenite was found disseminated in patches a few inches across in granite, and as flakes in quartz veins cutting granite, south of the Noatak River. Molybdenite also was found disseminated in garnet-epidote rock of contact metamorphic origin associated with granite exposed between Tupik and Angayu Creeks. Several masses of galena as much as an inch wide were found in quartz pods cutting metasedimentary rocks exposed between the two largest granite plutons in the area about 4 miles west of Awlinyak Creek. A little chalcopyrite was found on the east side of Lucky Six Creek north of the Noatak River. Thin coatings of malachite (and rarely azurite) were seen on several outcrops peripheral to the main granite pluton.

Unusually large pieces of crystalline hematite were found in rubble derived from hematite-quartz veins cutting marble on the north side of the Noatak River near Mount Papiok. The largest piece collected is about 4x5x8 inches, weighs about 30 pounds, and consists of a single "book" of tabular hematite crystals.

Surficial deposits cover an estimated 70% of the mapped area. These deposits include alluvium, colluvium, soils, and glacial drift. Generally the surficial cover is more extensive in the southern part of the area where relief is lower than in the central and northern parts. A wide array of features reflecting both a periglacial origin and a glacial origin were observed. These are erosional as well as depositional, and include talus, felsenmeer (block fields), protalus ramparts, rock glaciers, solifluction lobes, U-shaped valleys, faceted spurs, hanging tributaries, kames, kame terraces, moraines, and outwash plains. Although the determination of the glacial history of the area was not the primary objective of the field project, the data collected in aerial reconnaissance and ridge-top traverses, and from air photos, permit some tentative interpretations and correlations.

Pre-late Wisconsin glacial events in the report area are represented by ice-scoured uplands, erratic boulders as much as 2000 feet above present valley bottoms, and drift lacking good morainal form in the lowlands which border the south flank of the Brooks Range. Though undifferentiated here, these features may have originated during two separate ice advances. The earlier and more extensive of these advances may be of Illinoian age, and the later one of late Illinoian or early Wisconsin age.

Late Wisconsin events are represented by better preserved moraines and glacially striated outcrops in the major valleys of the region. One of the most conspicuous terminal or recessional moraines can be seen near the southern end of Walker Lake, and several outcrops along the lake shore show very well preserved striations trending southeast parallel to the direction of latest glaciation. Similar distinctly arcuate terminal or recessional moraines of probable late Wisconsin age also are found in the valleys of the Reed and Mauneluk Rivers and Beaver Creek near where these streams leave the south flank of the Brooks Range.

The most recent glaciation in the area is represented by 29 small remnant glaciers at relatively high altitude. Most are valley glaciers, but one caps the northern part of Oyukak Mountain. Short, very well preserved and very young valley moraines also occupy many of the highest valleys of the area no longer occupied by glaciers.

In late August, shortly before the field party returned to Fairbanks, an interesting archeological discovery was made. The Walker Lake campsite apparently had been occupied by Eskimo or Indian hunters hundreds or perhaps thousands of years ago. Flakes of chert were found on a main path within the site, and further search revealed an assortment of stone tools, including hand-axes, scrapers, knives and broken points. All of these artifacts were found beneath 6 to 8 inches of caribou moss and peat, and beneath the root systems of spruce trees as much as 200 years old. Mindful of the provisions of the recently enacted Alaska Antiquities Act, the search for artifacts was conducted as carefully as possible, and the site was mapped in detail. All of the artifacts found, plus photographs, charcoal for possible $C^{14}$ dating, a spruce section for tree-ring study, and a map of the site were turned over to the Department of Anthropology, University of Alaska.

The same features that attracted Alaska Geological Survey personnel to this site undoubtedly attracted the earlier occupants as well. The site included a stream-cut bench or terrace several tens of feet above lake level, with a commanding view of the lake to the south. In prehistoric time, or in the absence of modern vegetation such as spruce and alder thickets, it also would have provided an excellent view to the west and north. Its attractiveness was enhanced further by a spring issuing from a hole approximately 4 feet in diameter and more than 45 feet deep in a limestone outcrop less than 100 yards from the center of the campsite. This spring was flowing well in May before the spring breakup, and it apparently does not stop or freeze over during the winter. Its rate of flow in August 1971 was estimated to be approximately 2000 gallons per minute.