STATE OF ALASKA

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GEOCHEMICAL REPORT NO. 17

A Geochemical Investigation of the Wood River-Tikchik Lakes Area Southwestern Alaska

By

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A GEOCHEMICAL INVESTIGATION OF THE WOOD RIVER-TIKCHIK LAKES AREA SOUTHWESTERN ALASKA

By Gilbert R. Eakins

ABSTRACT

During part of the summer of 1967 a State Division of Mines and Minerals field party collected 372 stream sediment samples in the Wood River-Tikchik Lakes region of southwest Alaska to aid in determining the mineral potential. The samples were analyzed for heavy metals by field test and for copper, lead, zinc, molybdenum, and mercury by the laboratory. The results indicate that the mercury analysis is a good geochemical tool for prospecting in the region. Zinc appeared to be the best indicator of the heavy metals group. Geochemical anomalies and other field evidence indicated the most favorable locations for exploration are the following: (1) Marsh Mountain,(2) the south side of the southeast end of Lake Aleknagik,(3) the ridge on the south side of Sunshine Valley, and (4) the ridge on the south side of Little Togiak Lake.

INTRODUCTION

The unspoiled beauty of the lakes, glacial valleys, waterfalls and mountains, the excellent sport fishing, and the mild summer climate of the Wood River-Tikchik Lakes area create interesting possibilities for large-scale recreational use. Because of a possible conflict between recreational and mineral development of the region, this investigation to evaluate its mineral potential was initiated to assist the State Division of Lands in determining the best land classification for the most effective use. The investigation was also done to further the State Division of Mines and Minerals' program of geological study and geochemical sampling designed to provide useful information to prospectors and others interested in the development of mineral deposits.

The area examined includes the perimeters of the four major lakes of the Wood River Lake system and one of the six lakes in the Tikchik Lake system. This area is part of the Project Area Study of the Division of Lands which extends approximately 120 miles from north to south, averages about 30 miles in width, and encompasses approximately 3,100 square miles, or nearly two million acres. (See Fig. 1).

Working from south to north, the writer, assisted by Gerald Colp and John Wills, spent six weeks during the summer of 1967 collecting stream sediment samples and doing geological reconnaissance around the following lakes: (1) Lake Aleknagik, (2) Lake Nerka, including little Togiak Lake and Amakuk Arm, (3) Lake Beverly, including Golden Horn and Silver Horn, (4) Mikchulk Lake, (5) Lake Kulik, and (6) Nuyakuk Lake, west end. (See Figs. 9 & 10 in pocket). Aerial photos were largely used for the field mapping. Additional field work is planned for the 1968 season.

As a means for the rapid examination of areas and also to serve as a guide to more detailed mineral exploration, the sampling of stream sediments is the principal geochemical prospecting method used by the Division of Mines and Minerals. This method of sampling provides data on larger areas per sample than does geochemical sampling of soil, rocks, or vegetation because the weathering process causes fine materials derived from the entire drainage area of the stream to be represented in the stream sediments. The prospector should realize that geochemical sampling is by no means infallible. A sufficient number of samples must be collected to establish the background or normal values for the area and the threshold above which values are considered to be anomalous. Frequency distribution graphs of the sample analyses were used in this study as an aid to determining anomalous values.

Location and Accessibility

The Wood River and Tikchik Lakes are two large lake systems located in southwestern Alaska in an area beginning with Lake Aleknagik, eighteen miles north of the town of Dillingham on Nushagak Bay, and extending over eighty miles north to Nishlik Lake. The width of the area examined was largely determined by the configuration of the lakes, which are elongated in a generally east-west direction. The longest lake is Lake Nerka which extends 29 miles.

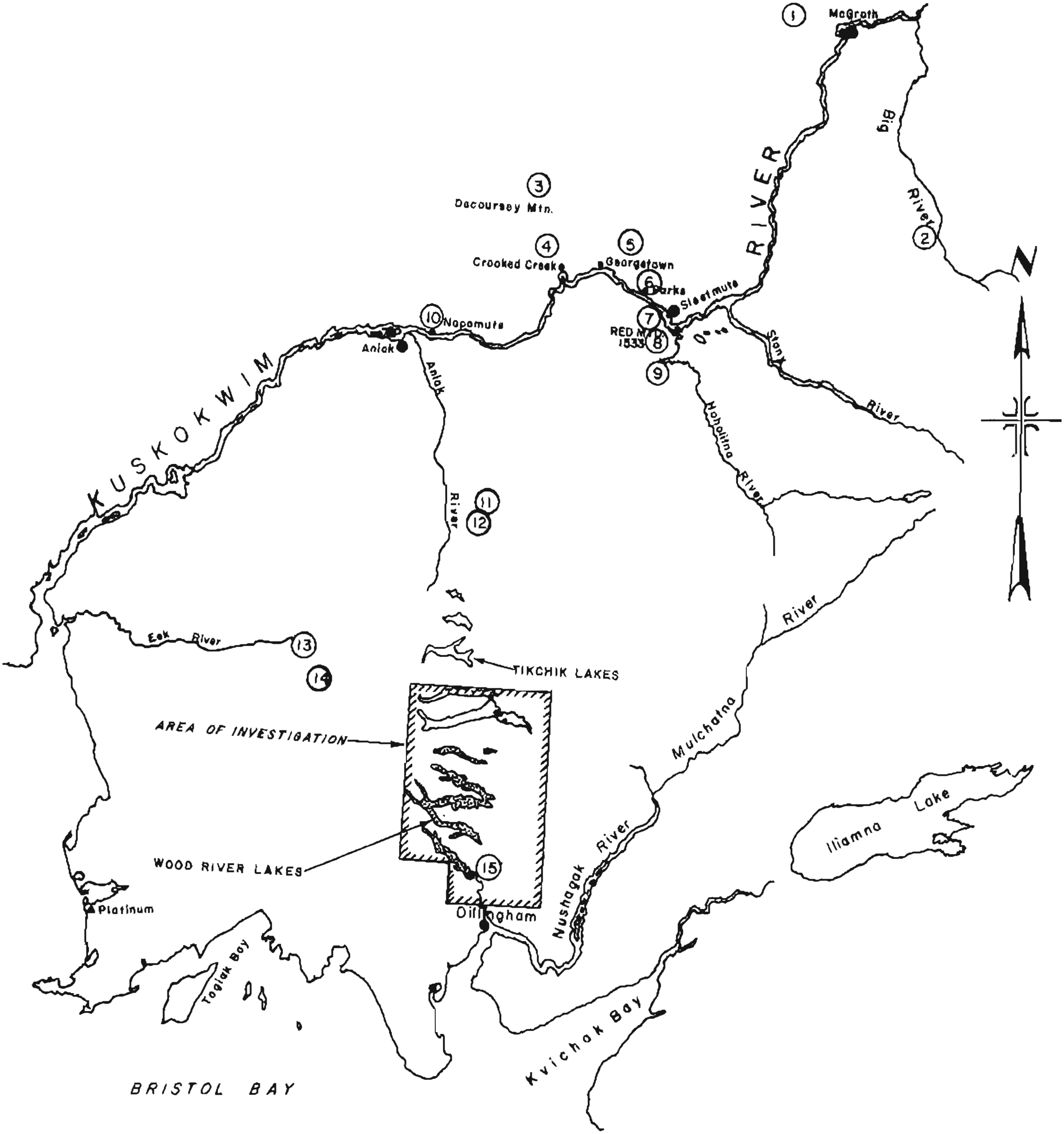
The Wood River Lakes are connected to one another by short rivers and have the Wood River at the lower end of Lake Aleknagik as their final outlet. Wood River drains into Nushagak Bay. The upper lake system, the Tikchik, drains into the Nuyakuk River, a tributary of the Nushagak River. The Nushagak in turn also drains into Nushagak Bay.

Dillingham offers the best nearby base for supplies and transportation into the area. Dillingham is a fishing town on Nushagak Bay, which is an arm of Bristol Bay, and can be reached by boat or ship. Two airlines, Northern Consolidated Airlines and Western Alaska Airlines, have scheduled flights to Dillingham and bush pilot services are available there from Stovall Air Service. Small boats, including commercial fishing boats, can reach Lake Aleknagik by traveling up Wood River, which enters Nushagak Bay about three miles north of Dillingham. A good gravel road also connects the village of Aleknagik at the lower end of Lake Aleknagik with Dillingham. There is a Post Office and a small landing field at Aleknagik.

Since it is the most accessible, Lake Aleknagik is the lake most populated and visited. Beyond Aleknagik there are no roads, and each lake farther to the north is more isolated than the one south of it. There are a few widely scattered cabins used as fishing camps on the different lakes.

Day-to-day field work was carried out from camps on the lake shores. Two 16-foot boats with outboard motors were used for reaching streams to be sampled and for examining outcrops near shore. Certain outcrops distant from the lakes were reached by foot. Dense brush and steep slopes made hiking very slow and difficult. The best bedrock exposures are on the ridge tops or at cliffs on the shorelines, the slopes for the most part being covered. The mountain ridges are bare rock.

The moving of the camp from lake to lake was accomplished by Fisheries Research Institute employees who towed the boats between lakes with shallow draft, jet-engine-powered motor boats. Camp gear and supplies were moved by float plane.



Location Map Showing Mercury Mines and Prospects

Ref: U.S. Bureau of Mines Information Circular 8131, 1962 "FIGURE 1"

1 Mount Joaquin	6 Parks (Alice and Bessie)	11 Lucky Day
2 White Mountain	7 Red Devil	12 Broken Shovel
3 DeCourcy Mountain	8 Barometer	13 Rainy Creek
4 Rhyolite	9 Fairview	14 Kagati Lake
5 Willis and Fuller	10 Kolmakof	15 Marsh Mountain (Red Top)

Climate and Vegetation

The annual precipitation in the area is approximately 34 inches. Most of precipitation occurs during the rainy season in July, August and September. In the summer the temperatures are generally cool. Foggy, windy, and rainy days are common and often make planned air service to the lakes very uncertain. The lakes are frozen from November to June.

The vegetation in the lake region is mostly of the low-growing types; dense alder, willow, and wild berries are the most typical varieties. Spruce and birch grow in patches in the low and flat areas.

History

The population and economy of the area are largely dependent upon the salmon industry. Federal, State, and private agencies have been active in the study of salmon spawning in the lakes since 1908. The work is presently conducted by the State Department of Fish and Game and the Fisheries Research Institute.

Only three or four small gold discoveries in the streams draining into the lakes have been reported. The only lode mine within the area is the Red Top mercury mine located on Marsh Mountain about five miles east of the village of Alekangik.

Cinnabar float was discovered by a prospector in 1941 in a stream on Marsh Mountain. This led to the discovery of a lode on top of the ridge near the southern end of the mountain. In 1952, under a Defense Minerals Exploration Administration contract, trenching uncovered the ore zone. In 1955, 560 feet of underground workings were driven. A total of 60 flasks of mercury are reported to have been produced in 1959, and enough ore stockpiled for another 60 flasks. When the writer visited the mine in the summer of 1967, one man had leased the property and was hand sorting the stockpiled ore. The Marsh Mountain property has been described by Sainsbury and Mackevitt (1965).

GENERAL GEOLOGY

Previous Work

The first geological survey to include the Wood River and Tikchik Lakes was that of the U. S. Geological Survey led by J. E. Spurr in 1898. The only specific geologic study of the area is U.S.G.S. Bulletin 903, The Nushagak District of Alaska, by J. B. Mertie, 1938. This report includes a geological map on a reconnaissance scale of 1:250,000 and a very good description of the physiography and geography of the region. The general geology of a broad area including the Wood River-Tikchik Lakes is included in a publication by Hoare (1961). References to the contiguous areas, the Goodnews quadrangle to the west, the Central Kuskokwim region to the north, and the mining districts of southwest Alaska are listed under references.

Physiography

The outstanding features of the area are the lakes, which are of unusually large size and of exceptional beauty. The principal lakes lie in a remarkably regular arrangement, being aligned nearly parallel in a general east-west trend, and being "stacked" evenly from north to south. The western or upper ends of the lakes are in the Wood River and Tikchik Mountains and their eastern or lower ends extend out into the Nushagak River Lowland. The Wood River and Tikchik Mountains merge with the Kuskokwim Mountains to the north and with the Kilbuck Mountains to the west. The area is also on the eastern margin of the large region which has been designated as the Ahklan Mountains physiographic devision. The landscape is the result of glaciation and stream erosion.

Going northwest from Dillingham across the Nushagak River lowland to the project area, beginning at the Village of Aleknagik, the mountains rise abruptly from near sea level to elevations of about 2500 feet along their eastern front and to maximum heights of 5000 feet farther west. The mountains have been sculptured by glaciers and display sharp peaks or horns, narrow comb ridges, glacial cirques and hanging valleys. Small remnants of glaciers still exist in the highest parts of the area.

The troughs occupied by the lakes have been scoured out of the bedrock by glaciers. Even the portions of the lakes extending beyond the mountain valleys out into the lowland occupy deep, bedrock basins and are not the result of damming by glacial deposits. The lakes have a maximum length of 29 miles and reach a depth of 900 feet. The walls of the troughs beneath the water are very steep and in many places vertical as far down as can be seen in the clear waters. The upper ends of the valleys in which the lakes lie are narrow and steep-walled, especially the arms of Lake Nerka, Lake Beverly, and Nuyakuk Lake. (See illistration on cover). The lakes widen where they emerge from the valleys into the flatlands. Many of the lower hills within mountainous areas have hummocky surfaces developed by glacial plucking.

Stratigraphy

All of the sedimentary and metamorphosed sedimentary rocks of the project area are included in the Gemuk Group which includes rock units of Mississippian (?), Permian, Triassic, and Lower Cretaceous ages, (Mertie, J.B., 1938). The total thickness of the group has been estimated to be between 15,000 and 25,000 feet thick. The most abundant rocks are argillite, siltstone, graywacke, chert, and greenstone. Minor amounts of Triassic and Permian limestone have been mapped locally on Lake Nuyakuk. The Gemuk Group has been intruded by Tertiary granite and monzonite stocks in four parts of the area, and both mafic and felsic dikes are widely present. Large areas contain Tertiary and Quarternary basic lavas. In general, the entire Gemuk Group is a fairly uniform dark gray, fine-grained monotonous sequence with little means to identify the different stratigraphic units. Table I, showing the general geologic column, serves to show the relationships of the formations in the Tikchik-Wood River Lakes area. The upper part of the Gemuk Group is exposed at the surface throughout the area examined by the writer except where Quaternary glacial and stream deposits or brush cover the bedrock. The upper part of the group is believed to be entirely Cretaceous in age and deposited under geosynclinal conditions. These rocks are for the most part hard, siliceous, very fine-grained, nonfossiliferous, and were probably derived from distant land masses and volcanic islands. The lower portion of the Gemuk Group, Triassic and older, was seen in part and only very briefly by the writer along the shore at the west end of Nuyakak Lake.

Contact metamorphism is evident around the intruded stocks as zones of hard, black, flinty hornfels. The width of these zones where the original argillities and graywackes have been "baked" by the intrusives varies from 1000 feet to nearly one mile.

TABLE I. GENERALIZED STRATIGRAPHIC SEQUENCE OF ROCKS IN LOWER KUSKOKWIM-BRISTOL BAY REGION, ALASKA

Period	Epoch	Unit Name	Character	Thickness(Feet)
Quaternary	Recent	Surficial deposits	Gravel, sand & silt deposited by streams and glaciers	0-450+
		— Unconformity —		
	Pleistocene	Basalt	Olivine basalt flows	50-350+
	?			
		— Angular unconformity —		
Tertiary		Not known		
	Late	Kuskokwim group	Graywacke, shale, conglomerate	20,000-30,000
	Early			
		— Unconformity —		
	?			
Jurassic	Late	Andesitic Volcanic rocks (Gemuk group)	Andesite and basalt flows, interbedded tuff, breccia, fine and coarse-grained sedimentary rocks	15,000-30,000
	Middle			
	Early	Gemuk group	Argillite, chert, greenstone, limestone, graywacke, tuff	
Triassic				
Permian				
Carboniferous				
		— Disconformity? —		
Devonian	Late or middle	Devonian limestone	Limestone, locally dolomitic	800-1,200
Silurian	Not known			
Ordovician	Not known	Not known		
Cambrian	Not known			
		— Angular unconformity —		
Precambrian			Metamorphic rocks Gneiss, schist, quartzite	

TABLE I from Hoare, J. M., 1961, Geology and Tectonic setting of Lower Kuskokwim-Bristol Bay region, Alaska; Am. Assoc. Petroleum Geologists Bull., v. 45, no. 5 (May), p. 598

Structure

The Tikchik-Wood River Lakes area is located between the Goodnews Arch on the west and the Alaska Range Geosyncline to the east (Hoare, 1961, pp 600, 601). Sediments which formed the Gemuk Group were deposited in a geosyncline present intermittently during Paleozoic and Mesozoic times. The rocks were tightly compressed and folded during late Cretaceous or early Tertiary time by forces acting northwest and southeast. The major structural elements trend northeast approximating the strikes of ancient geosynclinal axes. A regional fault zone, striking N 20^{o}-30^{o} E, crosses the northern part of the Tikchik Lakes, is the Togiak-Tikchik-Holitna fault. This fault has been projected from Bristol Bay northeast to a point 60 miles northeast of Nishlike Lake where it appears to encounter the Denali fault zone (Hoare, 1961, p 608). Faults which can be traced for several miles on aerial photos are present within the project area, and smaller faults visible both on aerial photos and on outcrops are very common and further complicate the structure.

The straightness of the fault traces on aerial photos indicates that the faults dip at high angles and are probably strike slip faults. Two fault systems are evident which strike northeast and northwest respectively. The alignment of many stream courses and the arms of the lakes suggest they are controlled by faults. Beds generally have steep to vertical dips resulting from compressive forces, but unless one can see actual banding due to color differences between thin beds, it is often difficult or impossible to determine their attitudes. Thick sections of the rocks do not have bedding fissility and will not part along bedding planes. However, secondary rock cleavage and jointing are prevalent and easily mistaken for bedding planes. All the sedimentary rocks are highly indurated and fractured, and some shaly beds are slaty and show shearing effects. Usually the only places where bedding can be determined with certainty is at the shorelines or where streams cut bedrock and water has polished outcrops revealing banding within the beds.

Mineralization

Southwestern Alaska is noted for its mercury deposits and is the leading mercury district of Alaska. Gold is the second most important mineral.

The only commercial mineral deposit that has been found within the area of this investigation is the Red Top Mercury Mine, but the region is nearly surrounded by scattered prospects. Whether the cause for the apparent scarcity of ore in the vicinity of the Wood River and Tikchik Lakes is due to unfavorable geology or to a lack of sufficient prospecting is uncertain. Granitic stocks, numerous dikes, and the recovery of small amounts of placer gold indicate that ore could be present here. The Gamuk group can serve as the host rock for ore as evidenced by the Red Top Mine and prospects both north and west of the Wood River-Tikchik Lakes. However, it appears that mineralization favors the outlying areas of low rounded hills bordering the Wood River-Tikchik River Lakes more than the area of rugged and youthful topography.

Mercury deposits of southwest Alaska have been found in mines and prospects as part of the fracture fillings in fault zones and in a variety of rock types. The most famous mercury mine is the Red Devil Mine near Sleetmute on the Kuskokwim River.

The Red Top Mine, on Marsh Mountain at an elevation of 1100 feet, was discovered by prospectors panning streams in 1941. Marsh Mountain is located near the village of Aleknagik and is about 18 miles north of Dillingham. The mine can be reached by a rough four-mile road which leads north to the mine from landing on Wood River about two miles east of Aleknagik. Clayton Rasmussen, who has a lease on the property, conducted the writer over the property.

The ore at the Red Top Mine was localized along open channels in a zone where a major fault cuts the large fold forming Marsh Mountain. Ten thousand feet of trenching and 560 feet of adits and drifts have exposed a 100-foot-wide shear zone containing brecciated graywacke and siltstone and white to yellow quartz carbonate vein material. The structure can be traced on the surface along its east-west strike for 2,000 feet. Dips are highly variable for the different faults within the shear zone, but they are predominantly between 35 to 70 degrees south. Complexity of faulting and dispersion of the ore throughout a wide zone present mining problems. Cinnabar occurs as fine disseminations and as pods and veinlets up to four inches wide and up to 30 feet in length. Limonite, causing a yellow to red coloration, is associated with the deposit; but stibnite, a mineral commonly associated with mercury, is absent. The only intrusive rock known in the vicinity of the mine is a ten-foot-wide basic dike, classified as minette, exposed in a gully about 100 feet north of the lower adit.

A little placer gold reportedly has been found by prospectors (1) in streams draining the ridge on the south side of Sunshine Valley, just west of the upper end of Lake Aleknagik, (2) in streams entering Lake Elva, (3) a small lake between the two arms of Lake Nerka; and (4) on the north and west sides of Tikchik Mountain on the north side of Tikchik Lake. The Wood River and Tikchik Mountains are not considered favorable areas for commercial placer deposits because glaciation probably has dispersed any pre-existing stream-deposited heavy metals. Erosion of the youthful mountains appears insufficient for the formation of commercial placer deposits in post-glacial time.

Placer gold, both in commercial and noncommercial quantities, has been found at a number of areas surrounding the Wood River and Tikchik Lakes. Placer gold has been located (1) on the northeast side of the Muklung Hills, about eight miles east of Marsh Mountain, (2) in streams in and around the Nushagak Hills, about 50 miles east of the Tikchik Lakes, (3) along several creeks in the Central Kuskokwim region, and (4) in the north central part of the Goodnews quadrangle. Tungsten has been mined at the head of Forty-seven Creek in the Central Kuskokwim region.

Kemuk Mountain is an outlying 1500-foot-high mountain twenty miles due east of Lake Kulik. Humble Oil and Refining Company located a large, low-grade magnetite deposit by geophysics on the east side of the mountain in 1959. Humble has diamond drilled the deposit and announced that there are several billion tons of material containing between 15 and 17 per cent total iron. No ore has been produced.

The principal mercury mines and prospects of Southeastern Alaska are shown on Figure 1.

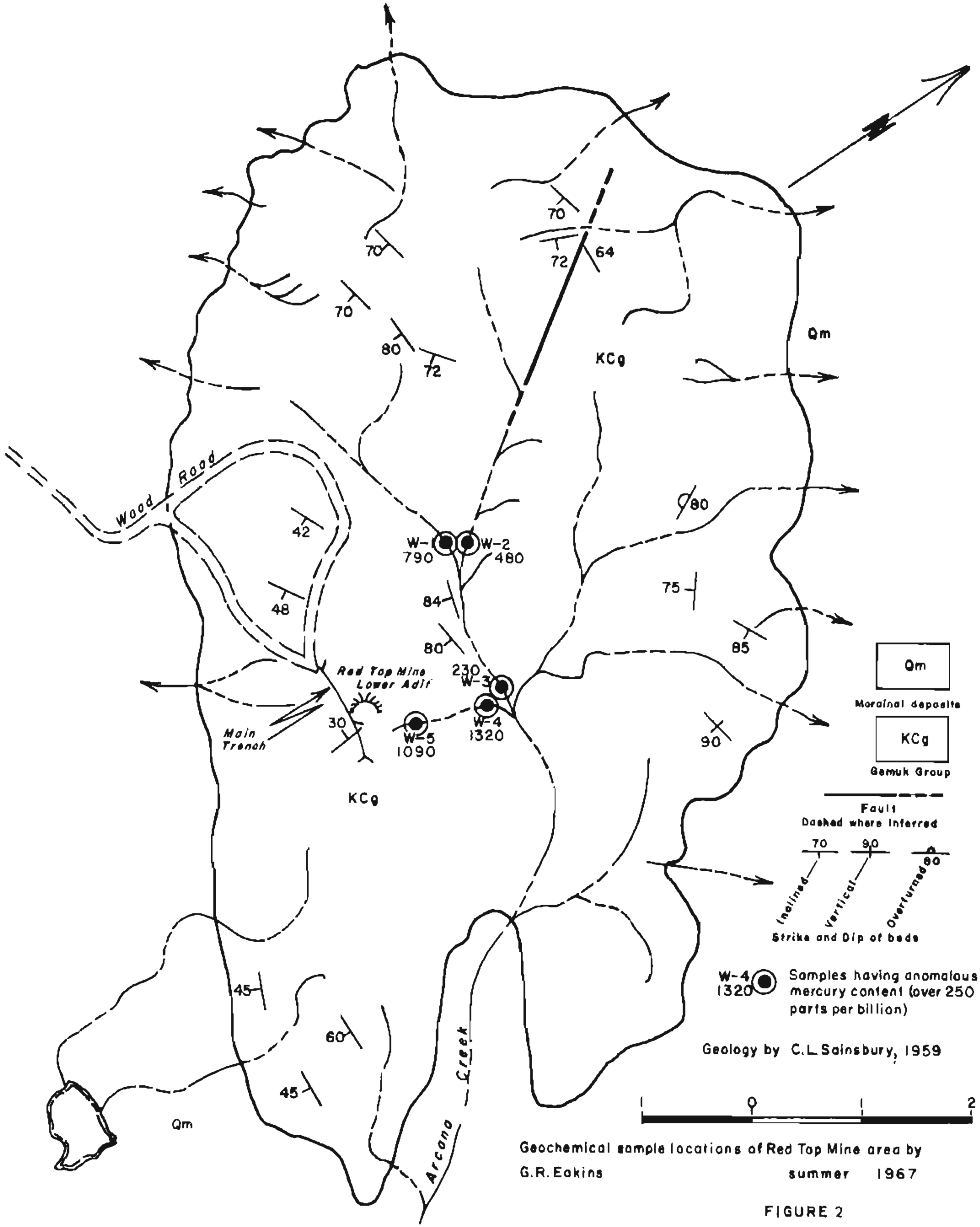

Qm
KCg
Wood Road
Red Top Mine Lower Adit
Main Trench
W-1 790
W-2 480
230 W-3
W-4 1320
W-5 1090
70
72
64
80
42
48
84
80
30
75
85
90
45
60
45
Arcona Creek
Qm
Morainal deposits
KCg
Gemuk Group
Fault
Dashed where inferred
70
90
80
Inclined
Vertical
Overturned
Strike and Dip of beds
W-4 1320
Samples having anomalous mercury content (over 250 parts per billion)
Geology by C.L. Sainsbury, 1959
0
1
2
Geochemical sample locations of Red Top Mine area by
G.R. Eakins summer 1967

FIGURE 2

Field Observations

The primary approach to the investigation of the subject area was geochemical stream sediment sampling of the accessible streams entering the lakes. Observations were made regarding the geology and indications of mineralization coincidentally with the sampling. The induration and metamorphism which created uniformity in the appearance of all the sedimentary rocks and the interbedded volcanics made rock identification difficult. About 100 rock samples were collected and 34 thin sections made for the purpose of classifying rocks which could not be properly identified in the field.

The rocks of the Gemuk Group from Lake Aleknagik north to Nuyakuk Lake display alternating dark and lighter bands that suggest cyclic seasonal deposition. The lighter colored bands may represent winter deposits and the darker bands more carbonaceous summer deposits. Individual bands vary from two to 15 inches in thickness. Basic and felsic dikes, up to 30 feet wide, were encountered in many places. Interbedded lavas are also seen included with the sediments. Granitic intrusives forming stocks up to several miles in length contain a variety igneous rocks, predominantly granite, quartz monzonite, granodiorite, and quartz diorite. Fine-grained equivalents of the above varieties were also found, and minor amounts of a basic porphyry were seen as float.

The most interesting geological structure seen by the writer in the Wood River Lakes area was the granite stock which is located between Lake Nerka and Lake Beverly and forms a large part of Akuluktok Mountain. Viewed from the west end of Silver Horn at the southwestern end of Lake Beverly, there is a remarkable exposure of the intrusive in a large glacial cirque, which forms an amphitheater with nearly sheer walls several hundred feet high on three sides. Jointing and sheeting of the granite area are displayed on a spectacular scale.

The most unusual feature of the structure is the draping of the sedimentary rocks over the top of the stock. Figure 3 shows this relationship. The lighter colored core is granite, and the darker beds curving over the top are argillite and siltstone beds altered by heat to a hornfels. The contact between the intrusive and sediments is visible on the west side of the cirque wall only, the sediments having been removed by erosion in other places.

In contrast to all the other sedimentary rock in the area which is highly folded and fractured, the beds overlying the intrusive south of the Silver Horn appear to be relatively undeformed and curve smoothly over the upper surface of the granite. This suggests that these beds were uplifted by the intrusive prior to regional folding and faulting and while in this position escaped the later deformation.

Small calcite veins and minor iron staining are fairly common in the area. Disseminated specks of pyrite within the shales and argillites is usual and could be the source of iron oxide seen along small faults.

Pyrite in veins and pods was found in boulders along a stream entering the south side of little Togiak Lake. This is the only area other than that near the Red Top Mine where a distinct anomaly was encountered by the geochemical heavy metals field test. The locality warrants further examination.

An area not visited by the writer but described by Mertie (p. 88) as exhibiting a diffuse type of mineralization and small intrusives is the ridge south of Sunshine Valley, west of the upper end of Lake Aleknagik. This locality is scheduled to be examined during the summer of 1968.

GEOCHEMICAL INVESTIGATIONS

Sampling Procedure

Geochemical stream sediment sampling was carried out in a manner judged to aid in the evaluation of as large an area as possible in the time available. Camps were made on the lake shores and two motor boats were used by the three-man field party for reaching the streams draining into the lakes. Streams in the region are of two general types: The small rapid streams draining the steep mountain slopes and the larger, slower streams and rivers in the large valleys and bordering the lowlands to the east of the mountains. Sampling was concentrated on the small streams descending steep slopes because of the closeness of bedrock. Due to the high velocity of these streams and the coarseness of the rocks in the stream beds, considerable time was often required to scrape up enough fines for an adequate sample.

Each stream was usually sampled only once, about 100 yards upstream from the shoreline. Some of the larger, more accessible streams in the vicinity of intrusive stocks were sampled at several locations. Silt-size material was dug out of the stream beds by bare hand and placed in a plastic sample sack which was sealed and labeled. The size of the samples was between one-half and one cup. Field tests were run in camp. If anomalous samples were found, a member of the party returned to the location from where they were obtained and a number of additional samples were taken.

Frequently the water in streams descending steep slopes disappeared into gravel and boulders forming alluvial fans long before reaching the shoreline. If the distance uphill to flowing water was too great to warrant taking the time to reach it, sediment samples were taken from the alluvial fan. These soil samples are apparently reliable indicators in the area. The one locality having a definite heavy metals anomaly was detected by this type of sample. A total of 372 sediment samples was collected.

Sample Analyses and Evaluation

Field tests were run for cold-extractable heavy metals, using the method described by Hawkes (1963). The heavy metals field test is a composite test for copper, lead, and zinc. The heavy metals test is believed to be the most practical general test to use in routine prospecting because of the high probability that most metallic deposits will contain appreciable quantities of one or more of the detectable metals. However, this does not apply to the search for mercury deposits. Mercury characteristically occurs with few associated metals other than antimony and arsenic in the Kuskokwim-Dillingham mercury belt. Field tests and laboratory analyses for heavy metals on samples collected immediately down hill from the Red Top mercury mine failed to show any anomaly. However, the laboratory analyses for mercury on the same set of samples did yield definite anomalies. Since the Wood River Lakes are within the mercury region of southwest Alaska, laboratory analyses for mercury were made in addition to the standard procedure of having analyses done on all samples for copper, lead, zinc and molybdenum. The mercury analyses were done by use of a mercury vapor detector and the values reported as parts per billion of mercury, (Table II).

A difficulty with the mercury analyses is that organic material in the sample can interfere and yield false high mercury values. This may have been the case in several of the anomalous results on the samples from the Wood River Lakes, especially where the field notes recorded the presence of noticeable amounts of organic material. An effort was made to avoid organic material, but in some locations, particularly where the streams were in low swampy or boggy areas, it was impossible.

Fig. 3 Granite intrusion, west end of Silver Horn, view looking south

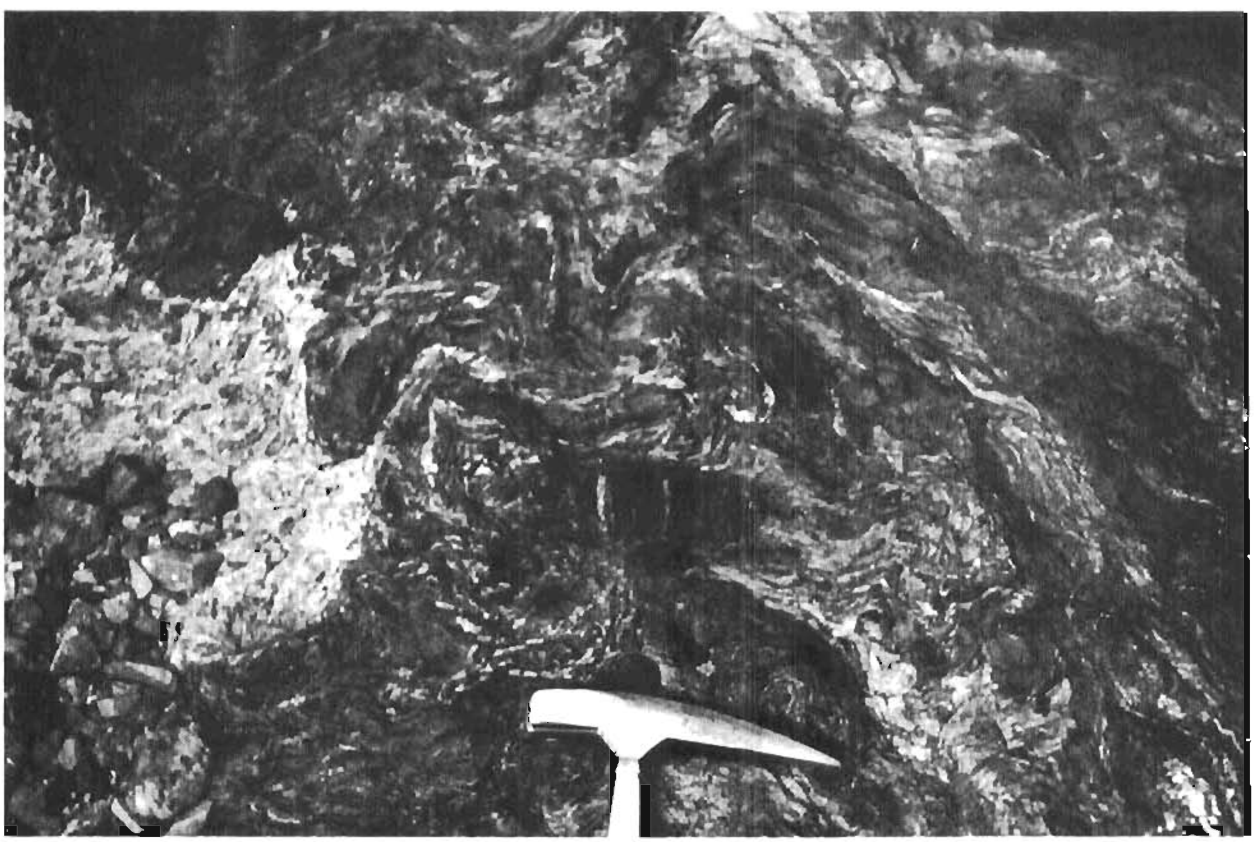


Fig. 4 Contorted carbonate bed, south side of Golden Horn

Anomalous values in this study have been determined by the frequency distribution graphs constructed for each metal (figures 6, 7, 8, 9). The bar on each graph which shows the metal content found most frequently is labeled "mode". Generally, anomalous values are those which are at least twice the mode.

Field tests and laboratory analyses have been grouped in Table II by the names of lakes, which indicate the general area from which the samples were obtained. Anomalous values are underlined. On the maps, sample locations are shown as solid dots and their numbers. Sample locations with anomalous values are indicated by circles around the dots.

An evaluation of the analyses shows that zinc and mercury are the most sensitive indicators for this area and that copper, lead, and molybdenum did not appear in sufficient quantities to indicate anomalies. A summary of the geochemical results follows.

Field Tests

The amount of dye required to yield a slate gray end-point in the field test is a measure of the amount of cold extractable metals in the sample. The more dye that is required the more heavy metals indicated. Experience on this project showed that from 0 to 5 milliliters of dye indicated normal background values; 5 milliliters or more dye indicated anomalous metal contents.

One anomaly was positively located by the field test. The location was a small stream on the south side of Little Togiak Lake. As a result of a low anomaly in a sample collected on an alluvial fan at the base of the ridge on the south side of Little Togiak Lake, a number of check sediment samples were taken between the bottom of the slope at the shoreline and a point upstream at an elevation of 1500 feet. Considerable pyrite was found in pods and veinlets up to three inches thick in boulders in the creek bed, but the mineralized material was not found in place. The climb upstream revealed several felsite dikes cutting the argillite bedrock, and much evidence of faulting. Dikes and small faults had a predominantly east-west trend. Field tests on the additional sampling required up to 20 milliliters of dye.

A lack of correlation of field tests and laboratory analyses was found to be common. A number of the samples yielding anomalous field tests, including those that located the above described mineralized area, did not show anomalies for any of the heavy metals in the laboratory analyses. This inconsistency indicates that under certain conditions the field tests measure some indicators that are not measured by the laboratory. An assay of a pyrite sample from the above locality yielded traces of gold and silver, (a trace of gold is less than 0.01 ounces per ton and a trace of silver is less than 0.1 ounces per ton).

Laboratory Analyses

Copper - The frequency distribution graph for copper does not show any erratic or anomalous values. The mode is 50-60 ppm, and no values of twice this amount were found. The symmetry of the copper graph indicates a normal spread of values, (see figure 5).

Zinc - The mode for the zinc analyses is 120-130 ppm, (see figure 6). The frequency distribution graph shows an erratic distribution of values beginning with 200 ppm and continuing upward to 300 ppm. A total of 23 samples gave anomalous zinc values.

Fourteen of these were collected in the same general locality on the south side of Little Togiak Lake in the anomalous area already described. The other anomalous samples were from scattered locations: Three from Golden Horn, four from Silver Horn and two from Nuyakuk Lake. A slight concentration of anomalous values from locations around Silver Horn may be the result of the granite intrusive south of Silver Horn.

Lead - The mode for the lead values is 20-30 ppm, (see figure 7). Only two of the samples yielded what were judged to be anomalous lead contents. These were 50 ppm. One of these was collected at the west end of Lake Beverley on the north shore. The other was collected on the south side of Lake Kulik near its west end. Neither sample is considered to be very significant because they are not supported by tests for other metals or field observations.

Molybdenum - The molybdenum values are all very low. The mode is 1-2 ppm, (see figure 7). One sample having a value of 5 ppm is considered anomalous. This sample, number E 114, collected on the south side of Silver Horn, also had an anomalous zinc content. This locality was shown by field tests on other samples as being slightly anomalous, and a number of check samples were collected in the general area. Traces of quartz veinlets with iron oxides were present as float in the area. Granite boulders indicated the nearness of the intrusive to the south. The bedrock is dark argillite which has a "baked" appearance.

Mercury - The mercury analyses provided the most interesting results of the entire investigation. The analyses on five test samples collected down-slope from a known mercury deposit on Marsh Mountain served as a check and show that the mercury test will detect anomalous amounts of mercury in sediments in this area. The mode of mercury analyses is 50-100 ppb, (see figure 8). All values over 250 ppb are classed as anomalous in this study. Of the 372 samples analyzed, 40 were reported to have mercury contents over 250 ppb.

DISCUSSION OF MERCURY SAMPLING

Due to the fact that organic material in the sample will volatilize and interfere with the mercury analyses as done by the mercury vapor detector, the results must be interpreted with this in mind. A rerun on the twenty samples having the highest values was requested in an effort to determine the reliability of the analyses. The reruns agree reasonably well with the original runs.

A letter from Rocky Mountain Geochemical Corporation regarding the mercury analyses contained the following information:

> "In regard to organic interference in mercury determinations, our detector is equipped to filter off the organic vapors but does not do so effectively on high organic samples. Therefore, the high organic samples give high mercury values, but they tend to have a leveling effect dependent on just how heavy the organic matter is. If the organic matter is uniform, then heavier values of mercury would register over the organic interference.
>
> The three +2500 ppb values were from samples that did not show real heavy organic matter. Also your JC-1 through JC-129 series did not show heavy organic matter. On the reanalysis of 20 samples the following showed heavy organic matter: JW-14, JW-47, JW-52, JW-60, GE-112, and GE-116. The others were not significantly heavy."

While the interpretation of the results of the mercury analyses should be tempered because of the presence of more or less amounts of organic material, the writer believes that the findings are significant and that areas are indicated in the Wood River Lakes region where more detailed sampling should be done. The highest concentration of anomalous values is in the general area of Lake Aleknagik, and the number decreases progressively to the north from this lake. A brief discussion of the anomalous mercury values by areas follows:

Marsh Mountain

Three samples were collected along a gully immediately below (north) the lower adit of the Red Top mercury mine, and two more from two branches of the stream at the bottom of the slope. Four of the five samples produced anomalous mercury values with mercury contents from 480 ppb to 1,090 ppb. The other sample was near anomalous with a value of 230 ppb. The two samples from small branch streams may not represent drainage from the Red Top mine and suggest that further sampling west and north of the mine would be wise. The writer believes that sampling of the entire area of Marsh Mountain might be justified to search for a possible extension of the Red Top mine ore zone or for a possible separate zone.

Southeast End of Lake Aleknagik

The most pronounced anomalies of the entire Wood River Lakes investigation appeared at the lower end of Lake Aleknagik in streams on the south side. Six samples between Whitefish Creek, about two miles northwest of the village of Aleknagik, and Bear Bay, three additional miles northwest, yielded anomalous mercury values; No. W-6 over 2,500 ppb, No. W-7 over 2,500 ppb, No. W-8 370 ppb, W-9 480 ppb, W-10 over 2,500 ppb, and E-4A 490 ppb. Across the lake, on the northwest side, and about three miles west of the Red Top mine, sample No. W-14 had 580 ppb, but was high in organic matter. If, however, sample No. W-14 is included with the anomalous samples, then it helps to define an anomalous area which may extend from Marsh Mountain westward across the lake and along its southeast shoreline for a total length of nine miles. Future investigations should include the southeast end of Lake Aleknagik and the area south and west from the shore to the mountains.

The areas from where the strong anomalies were encountered are in relatively flat ground and between one and three miles from the steep slopes of the mountains on the south. The bedrock is predominantly argillite. Some two-inch quartz veins and iron oxide were found by the writer on the hill on the peninsula between Bear Bay and Lake Aleknagik near sample location E-4A.

Northwest Part of Lake Aleknagik

Eight more samples from the Lake Aleknagik area showed anomalous mercury values which range from 250 ppb to 1650 ppb. Three of these were collected on the south side of the lake and five on the north side. These eight samples are rather widely spaced and most contained appreciable amounts of organic material. There are reservations regarding their significance but they should not be discounted completely because of the supporting samples in the general area of Lake Aleknagik. The sample numbers are E-6, E-7, E-8, E-17, W-13, W-18, and J-7. The bedrock is argillite and no evidence of mineralization was observed.

Little Togiak Lake, South Side

Ten of the samples collected from the south side of Little Togiak Lake (an arm of Lake Nerka) gave anomalous mercury values which ranged from 250 ppb to 380 ppb.

All but one of these, No. J-53, were collected within the same general area found to be anomalous by field tests and laboratory analyses for zinc. Therefore, the mercury analyses support the heavy metals tests which located the pyrite vein material already described. The anomalous samples are numbers E-61, E-62, E-63, E-66, E-68, E-71, J-42, J-49, J-53, and J-59.

Other Anomalous Mercury Samples

Three samples of soil from the slope on the south side of Silver Horn (an arm of Lake Beverley) and about midway between the ends of the arm were anomalous. The local area was heavily sampled to check a field test anomaly. The mercury values for samples numbered E-112, E-116, E-119 were 430 ppb, 640 ppb, and 250 ppb. The bedrock up to the elevation sampled, about 300 feet, was found to be argillite, but float contained basic dike rock, sheared fault zone material, and traces of calcite, quartz, and iron oxide. Evidence of mineralization was not strong, but it seems advisable to examine the area farther up-slope with continued stream and soil sampling.

The remaining anomalous mercury values are from sample locations scattered throughout the lake system. No great significance is attributed to these samples because of the high organic contents and the lack of supporting evidence of mineralization. The following list locates these samples and gives the mercury analyses.

W-43, 390 ppb, north side of River Bay, which connects Lake Aleknagik and lower Lake Nerka.

J-59, 270 ppb, south side of River Bay, possibly on a continuation of an anomalous zone detected by sample W-43.

W-52, 960 ppb, southeast end of Lower Lake Nerka, south side. This sample was high in organic matter.

W-47, 560 ppb, south side of lower Lake Nerka; high in organic matter.

W-60, 1,100 ppb, south side of upper Lake Nerka, high in organic matter.

E-50, 260 ppb, north side of Upper Lake Nerka.

E-112, 430 ppb, stream southwest of the west end of Silver Horn; high in organic matter.

W-106, 280 ppb, west end of Lake Nuyakuk.

W-100, 590 ppb, west end of Portage Arm, an arm of Lake Nuyakuk; a sample from a small flood plain, probably organic.

SUGGESTIONS FOR PROSPECTING

Present information on the Wood River Lakes region indicates that the most favorable areas for prospecting are: (1) Marsh Mountain, (2) the southeast end of Lake Aleknagik, (3) the ridge on the south side of Sunshine Valley, and (4) the ridge on the south side of Little Togiak Lake.

Ores of either gold or mercury may be found in the Wood River Lakes area. Gold is often associated with small granitic intrusives similar to those in this region, and areas bordering features of this type are considered to be favorable for prospecting. The presence of minor amounts of gold suggests that small commercial placer gold deposits in post-Pleistocene gravels is possible. Gold in veins has not been found in this area, and the reported small and scattered occurrences of placer gold in the streams draining the ridge on the south side of Sunshine Valley and in those streams entering Lake Elva, are not too encouraging. It is likely that glaciation has disrupted the accumulation of placers.

A rumor that cinnabar nuggets have been found on the northwest shore of Lake Chauekuktuli by natives was not verified. The area is north of that covered by the writer. It may warrant investigation.

The presence of mercury at a number of mines and prospects in southwestern Alaska and at the Red Top mine in particular makes mercury the prime prospect in the report area. Guides to use in prospecting for mercury in the area are as follows:

1. Fault or shear zones in brittle rock which have provided channels for ore-forming solutions. Unfortunately these are usually undetectable.

2. Silica-carbonate veins and associated iron oxides which may be traced by stream float.

3. Mineralization may produce rock alteration which produces light-colored iron-stained siltstone and graywacke.

4. Panning for cinnabar in the same manner as for gold is basic to mercury prospecting. A hand lens can be used to identify small amounts of cinnabar. Geochemical prospecting is recommended. Lodes can be located by following the placer cinnabar upstream and uphill.

The suggested procedure after finding a geochemical anomaly is to attempt to localize the mineralized area by additional stream sampling and then by soil sampling and panning. After locating the source area the next step is the examination of the bedrock by trenching and drilling test holes.

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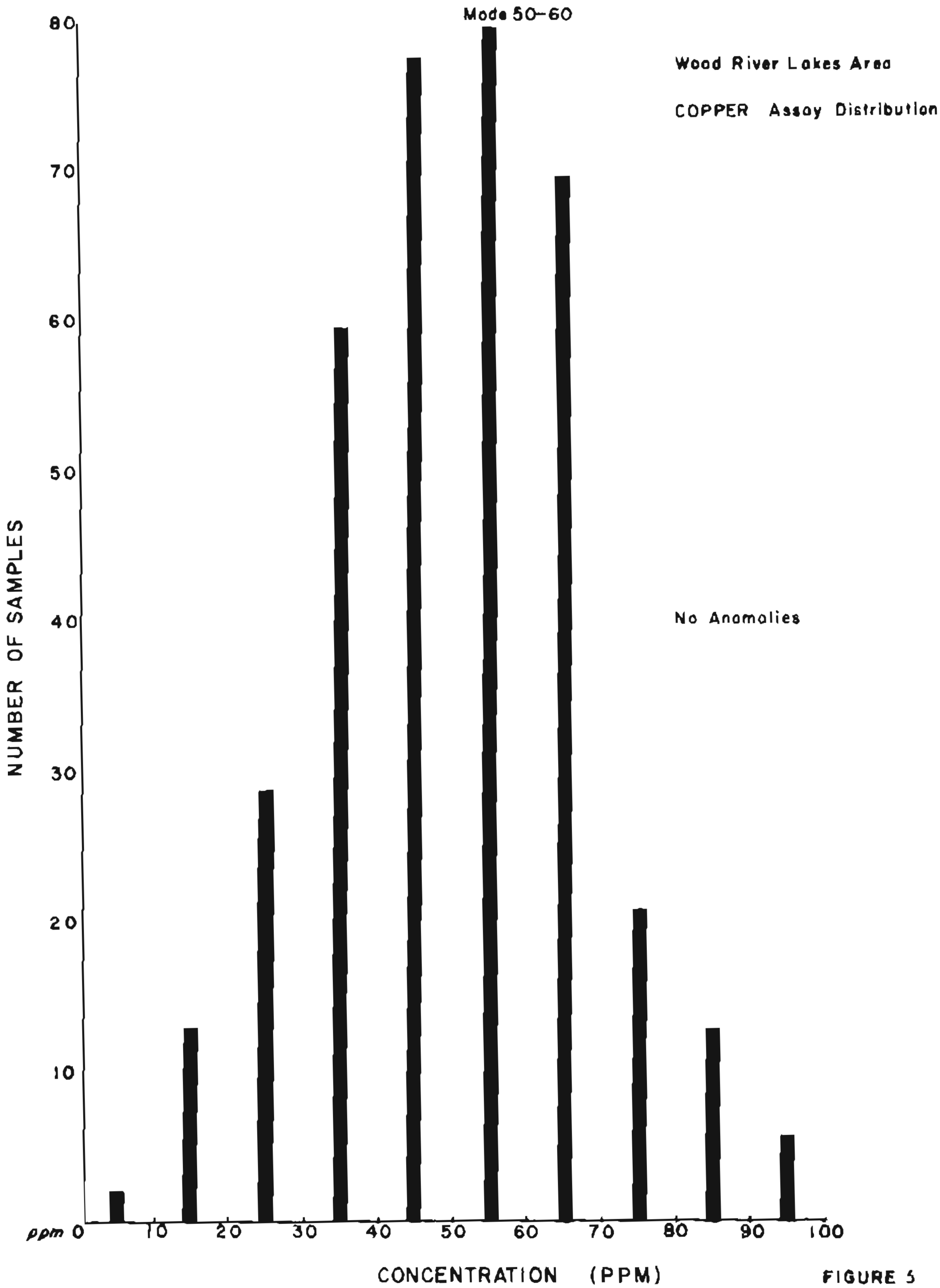

Mode 50-60
Wood River Lakes Area
COPPER Assay Distribution
No Anomalies
NUMBER OF SAMPLES
80
70
60
50
40
30
20
10
ppm 0
10
20
30
40
50
60
70
80
90
100
CONCENTRATION (PPM)

FIGURE 5

Wood River Lakes Area

ZINC Assay Distribution

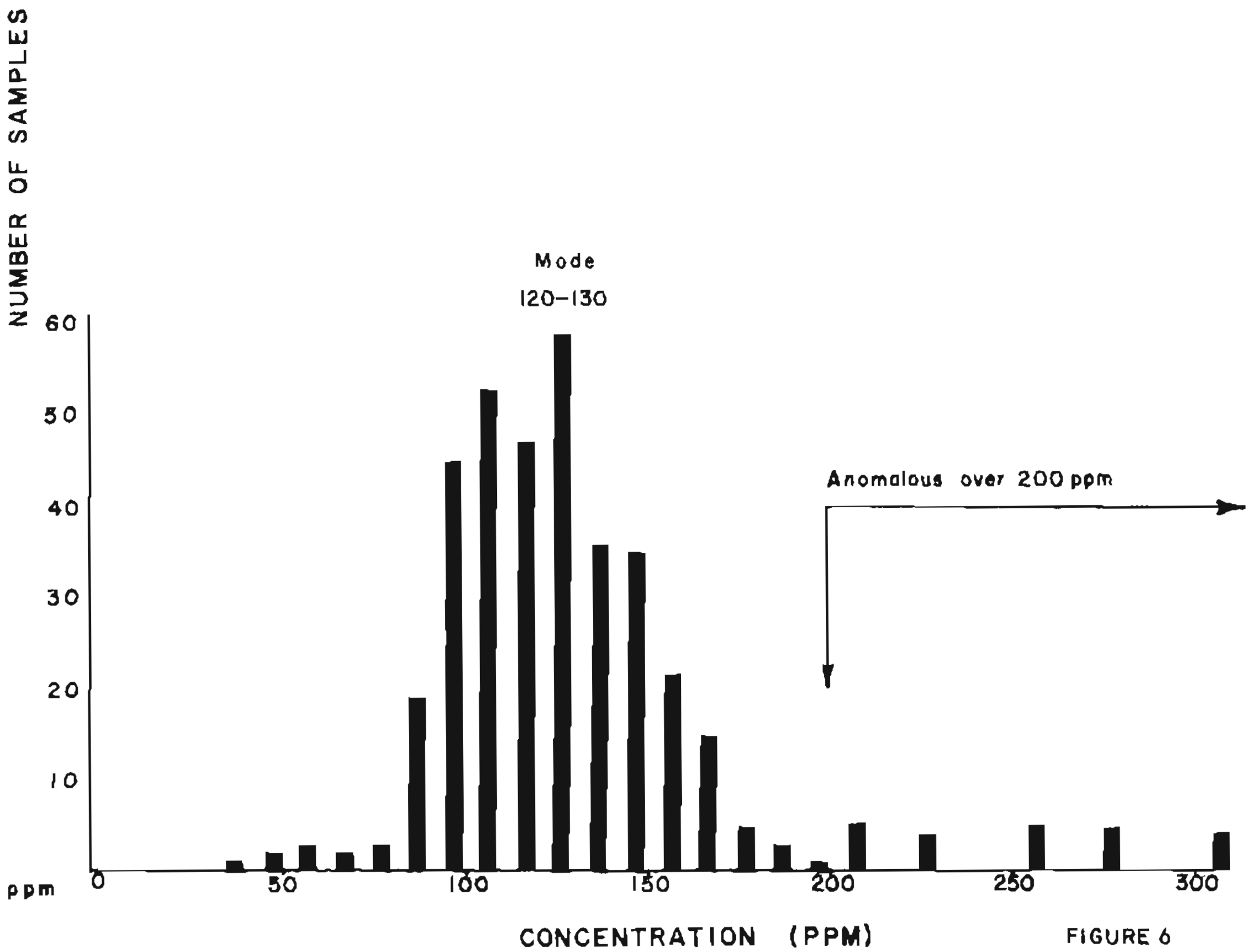
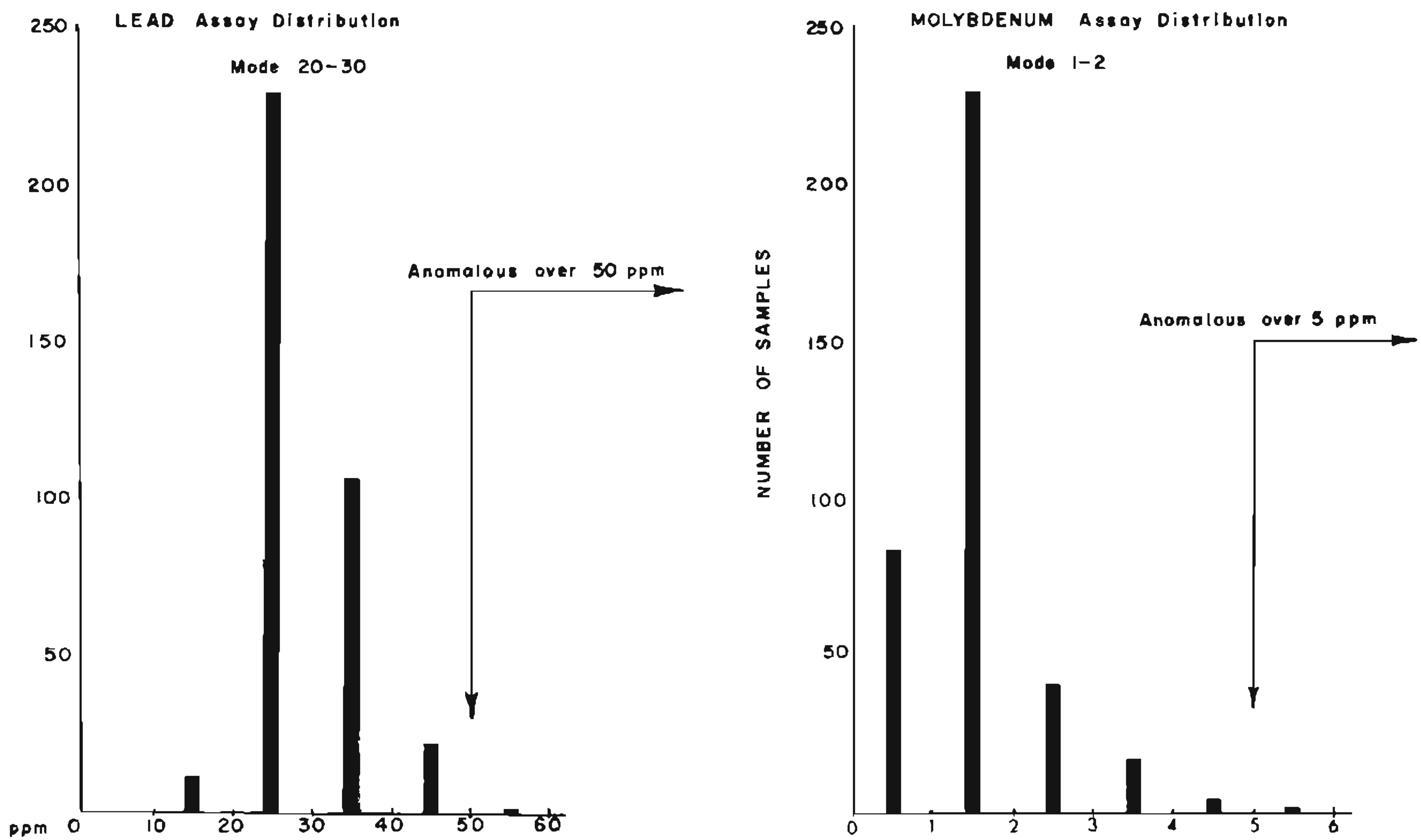


FIGURE 6

Wood River Lakes Area



CONCENTRATION (PPM)

FIGURE 7

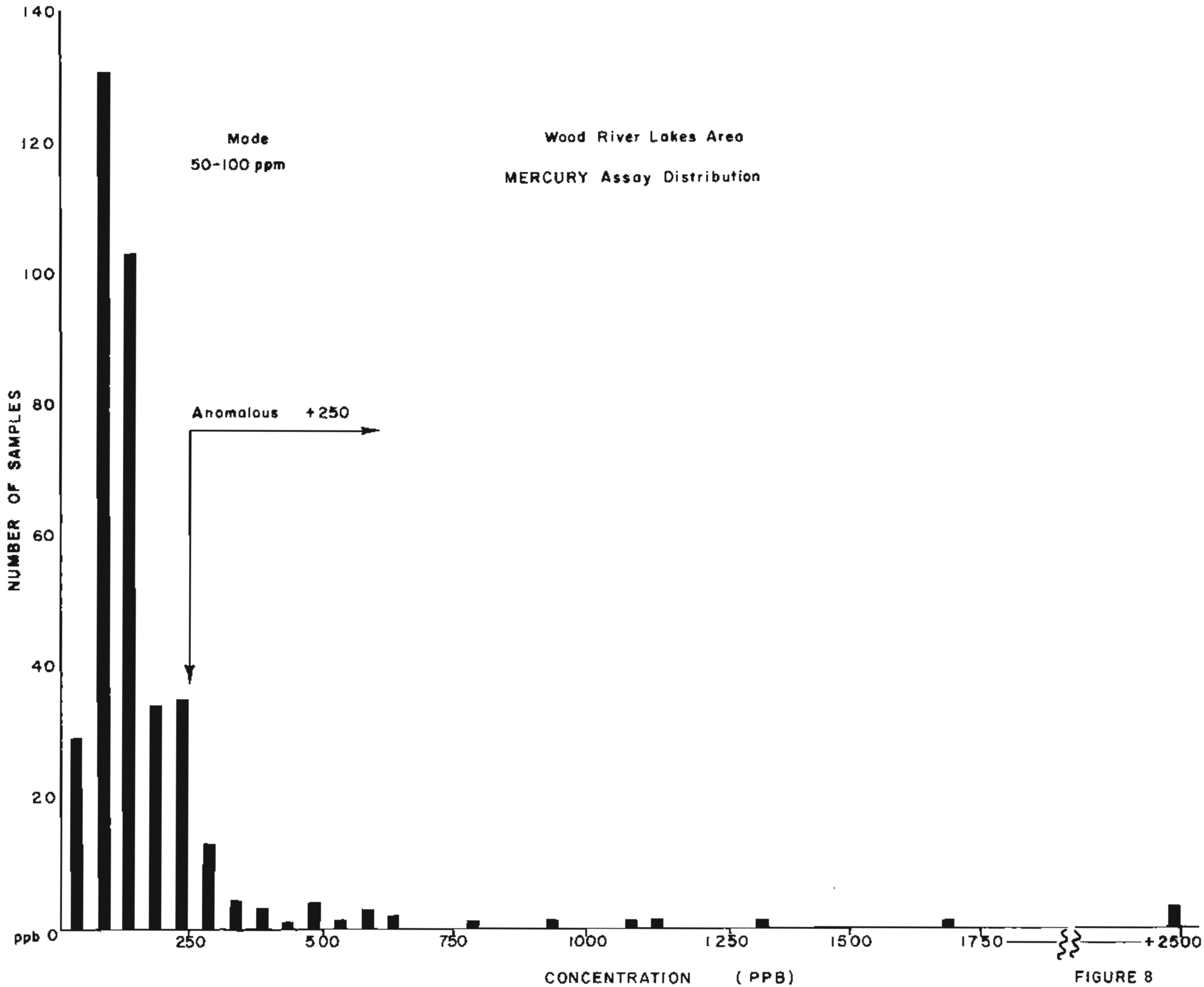

Wood River Lakes Area
MERCURY Assay Distribution
Mode
50-100 ppm
Anomalous +250
NUMBER OF SAMPLES
140
120
100
80
60
40
20
ppb 0
250
500
750
1000
1250
1500
1750
+2500
CONCENTRATION (PPB)

FIGURE 8

Table II

Analyses for Copper, Zinc, Lead

and Field Tests

Wood River-Tikchick Lakes Area

(Anomalous values are underlined)

Lake Aleknagik General Area

Sample No.	Ml Dye	ppm Copper	ppm Zinc	ppm Lead	ppm Molybdenum	ppb Mercury
J- 1	1	30	135	20	2	170
J- 2	1	45	140	20	1	180
J- 3	0	50	125	20	2	140
J- 4	1	35	105	20	1	90
J- 5	0	15	90	20	-1	80
J- 6	1	40	105	30	1	130
J- 7	0	55	120	30	1	310
J- 8	0	55	125	30	2	200
J- 9	0	55	115	30	1	120
J-10	0	60	115	30	2	80
J-11	0	55	110	30	-1	80
J-12	0	50	130	20	1	50
J-13	0	45	120	20	1	150
J-14	1	50	130	30	1	230
J-15	1	50	140	20	1	170
J-16	0	45	150	20	1	110
J-17	1	45	135	20	1	180
J-18	1	40	125	20	1	120
J-19	3	50	145	40	1	130
J-20	1	45	140	20	1	190
J-21	1	45	140	20	1	130
J-22	0	50	140	20	2	120
W- 1	2	60	130	20	-1	790
W- 2	3	60	120	20	-1	480
W- 3	0	70	135	20	1	230
W- 4	1	60	120	30	-1	1320
W- 5	3	70	120	30	-1	1090
W- 6	1	20	105	20	-1	+2500
W- 7	1	40	120	20	1	+2500
W- 8	3	30	115	20	-1	370
W- 9	1	30	105	20	-1	480
W-10	4	45	130	20	1	+2500
W-10c		35	130	20	1	230
W-11	1	40	110	20	-1	140
W-12	3	35	100	20	-1	200
W-13	1	40	110	20	1	600
W-14	3	15	85	20	1	580
W-15	0	20	90	20	-1	100
W-16	1	20	95	20	-1	70
W-17	1	45	140	20	1	230

Sample No.	Ml Dye	ppm Copper	ppm Zinc	ppm Lead	ppm Molybdenum	ppb Mercury
W-18	1	60	135	30	-1	500
W-19	1	45	105	20	1	120
W-24	1	50	105	20	2	190
W-25	0	50	125	30	1	170
W-26	0	30	105	20	-1	110
W-27	1	40	115	30	3	90
W-28	2	40	95	20	1	100
W-29	1	30	80	20	1	150
W-31	1	50	95	20	-1	130
Ice Creek Clay		65	140	20	1	
E- 4A		60	85	20	1	490
E- 6	0	40	115	20	2	200
E- 6	3	35	90	20	1	310
E- 7	2	30	105	30	1	320
E- 8	1	50	120	30	1	490
E- 9	0	45	100	20	-1	130
E-11	0	20	100	20	-1	130
E-12	1	30	105	20	1	50
E-13	1	35	110	20	1	130
E-14	1	25	105	20	1	90
E-15	1	10	40	10	2	1650
E-16	1	35	115	20	1	150
E-17	1	25	105	20	2	250

Lake Nerka General Area

Sample No.	Ml Dye	ppm Copper	ppm Zinc	ppm Lead	ppm Molybdenum	ppb Mercury
J-23	1	20	70	10	1	30
J-24	1	5	55	10	1	20
J-25	1	10	65	10	1	20
J-26	1	30	110	10	2	20
J-27	0	50	125	20	-1	20
J-28	1	45	110	20	1	50
J-29	1	55	130	20	1	20
J-30	0	55	135	30	1	20
J-31	0	20	45	10	1	20
J-32	0	15	55	10	2	20
J-33	0	30	80	20	2	30
J-34	0	50	130	20	1	30
J-35	1	45	130	30	1	20
J-36	0	50	150	30	1	60
J-37	2	60	155	20	-1	200
J-38	1	50	150	20	2	140
J-39	1	50	140	40	1	120
J-40	0	50	165	30	4	230
J-41	1	55	205	30	2	240
J-42	1	55	225	30	2	300
J-43	1	55	150	20	1	170
J-44	1	50	160	20	1	210
J-45	2	60	175	20	1	140
J-46	2	60	160	20	1	110
J-47	1	75	200	30	2	140
J-48	3	60	155	30	1	140
J-49	4	60	170	30	1	260

Sample No.	Ml Dye	ppm Copper	ppm Zinc	ppm Lead	ppm Molybdenum	ppb Mercury
J-50	1	35	140	30	1	150
J-51	2	45	155	20	1	110
J-52	2	45	140	20	1	80
J-53	1	45	130	20	1	260
J-54	5	20	120	20	-1	90
J-55	2	50	140	20	1	140
J-56	1	35	115	20	1	120
J-57	3	25	105	20	1	210
J-58	2	40	115	20	1	210
J-59	3	55	125	20	1	270
J-60	0	40	115	20	1	150
J-61	1	45	140	20	-1	100
J-62	1	40	105	20	1	120
J-63	1	45	100	20	-1	110
J-64	1	50	105	20	1	140
J-65	4	45	115	20	1	200
J-66	1	60	120	20	1	150
J-67	3	25	100	20	1	210
J-68	3	30	125	20	1	140
J-69	1	55	120	20	-1	140
J-70	5	45	110	20	1	230
J-71	3	40	150	20	1	110
J-72	3	30	95	20	1	60
J-73	3	20	130	20	1	80
J-74	3	50	100	20	1	80
J-75	2	45	120	20	1	100
J-76	0	45	110	20	1	80
J-77	0	50	120	20	2	50
J-78	1	65	115	30	1	80
J-79	1	60	110	30	-1	80
J-80	0	65	110	30	-1	60
J-81	2	65	120	30	2	90
J-82	2	60	115	20	-1	80
J-83	0	60	120	20	-1	80
J-84	0	55	100	20	-1	40
J-85	1	65	105	20	-1	30
J-86	1	25	95	20	-1	60
J-87	1	35	135	20	-1	110
J-88	1	30	115	20	-1	80
J-89	1	55	165	30	1	170
J-90	1	50	160	30	1	90
J-91	1	40	100	20	1	60
J-92	1	15	120	20	1	110
J-93	1	15	85	20	1	150
E-19	3	45	140	20	1	130
E-24	2	35	155	30	1	210
E-26	3	60	110	20	1	120
E-28	1	60	125	20	1	110
E-29	1	50	95	20	1	60
E-31	1	60	165	20	2	110
E-32	1	50	140	20	1	40
E-33	5	50	175	20	1	70
E-34	2	55	165	20	-1	70

Sample No.	Ml Dye	ppm Copper	ppm Zinc	ppm Lead	ppm Molybdenum	ppb Mercury
E-35	7	50	170	30	1	40
E-39	3	30	95	20	1	80
E-40	1	25	80	20	1	100
E-42	1	10	65	10	-1	40
E-43	2	35	120	20	1	80
E-44	1	25	95	10	3	60
E-45	1	20	100	10	4	40
E-46	1	35	95	20	1	40
E-47	1	25	90	20	1	70
E-48	2	55	100	20	1	90
E-50	20	60	105	20	-1	260
E-51	5	40	115	20	1	150
E-52	4	40	105	20	1	130
E-53	3	40	115	20	3	80
E-54		30	140	20	1	70
E-56	2	30	90	20	-1	100
E-57	2	20	95	20	1	70
E-58	5	60	150	30	1	110
E-59	20	60	145	20	1	90
E-60	5	60	205	30	2	240
E-61	16	60	275	40	3	380
E-62	5	50	275	40	3	260
E-63	3	55	300	40	2	250
E-65	4	55	300	40	2	230
E-66	2	60	275	40	2	250
E-68	3	60	300	30	3	270
E-69	3	55	225	40	1	180
E-71	5	60	300	40	2	260
E-72	3	60	145	30	2	80
E-73	2	60	150	30	1	110
E-74	2	60	140	30	1	90
E-75	3	60	110	30	1	70
E-76	3	50	100	30	1	90
E-77	2	50	80	30	1	180
E-78	2	55	115	20	1	140
E-79A	3	60	110	30	-1	120
E-79B		50	95	20	1	80
E-80	3	55	105	20	1	80
E-81	2	50	105	20	1	60
E-82	3	55	120	20	1	60
E-83	4	50	120	20	1	40
E-84	3	50	120	20	1	40
E-85	4	70	145	20	1	70
E-86	2	55	165	20	1	60
W-32	1	60	160	30	1	120
W-33	2	55	165	30	2	190
W-34	5	60	250	40	1	200
W-35	7	70	155	40	1	150
W-36	1	15	100	20	2	80
W-37	2	40	140	30	1	100
W-38	2	45	140	30	-1	110
W-39	1	30	80	20	1	140
W-40	1	40	120	30	1	140

Sample No.	Ml Dye	ppm Copper	ppm Zinc	ppm Lead	ppm Molybdenum	ppb Mercury
W-41	3	40	130	30	1	100
W-42	3	40	125	30	1	230
W-43	2	40	120	30	1	390
W-44	1	55	130	30	1	210
W-45	1	35	130	30	1	110
W-46	2	50	130	30	1	130
W-47	4	35	125	30	1	560
W-48	2	35	100	20	1	120
W-49	0	30	115	20	1	90
W-50	0	30	95	20	1	130
W-51	3	25	100	20	2	210
W-52	2	30	90	20	1	960
W-54	1	55	120	20	1	200
W-55	1	50	135	20	1	170
W-56	1	30	125	20	2	110
W-57	3	40	130	20	-1	90
W-58	3	50	110	20	-1	60
W-59	3	25	135	20	1	60
W-60	1	10	45	30	4	1100
W-61	1	20	90	20	-1	60
W-62	1	15	85	20	-1	210
W-63	5	20	120	20	-1	40
W-64	6	20	105	20	1	40
W-65	16	60	120	30	3	190
W-66	8	60	155	20	1	80
W-67	5	50	275	30	3	200

Lake Beverley General Area

Sample No.	Ml Dye	ppm Copper	ppm Zinc	ppm Lead	ppm Molybdenum	ppb Mercury
J-94	1	25	100	20	1	120
J-95	1	10	95	20	1	50
J-96	0	20	120	20	1	90
J-97	1	20	85	20	-1	70
J-98	0	40	95	20	1	100
J-99	1	40	100	20	1	150
J-100	0	40	100	20	1	90
J-101	1	40	115	20	-1	120
J-102	0	40	95	20	-1	90
J-103	0	20	80	20	-1	110
J-104	0	55	120	30	-1	80
J-105	1	45	140	30	-1	90
J-106	0	70	110	20	1	80
J-107	1	60	125	30	1	60
J-108	0	50	100	20	1	50
J-109	0	55	160	20	1	50
J-110	0	50	150	30	1	80
J-111	1	60	125	30	-1	60
J-112	0	70	125	30	-1	40
J-113	2	80	205	40	-1	30
J-114	0	60	200	30	-1	90
J-115	2	70	150	30	1	90
J-116	8	65	165	30	2	90
J-117	1	75	135	30	-1	120
J-118	2	60	145	20	1	50

Sample No.	Ml Dye	ppm Copper	ppm Zinc	ppm Lead	ppm Molybdenum	ppb Mercury
J-119	2	70	185	30	1	80
J-120	1	60	135	30	-1	80
J-121	5	75	190	30	3	110
J-122	1	40	100	20	1	50
J-123	1	30	95	20	1	60
J-124	5	40	100	20	-1	70
J-125	1	40	95	20	-1	80
J-126	0	45	100	20	1	80
J-127	1	30	90	20	1	80
E- 88		45	125	20	2	80
E- 89		50	130	20	1	100
E- 90		40	95	20	1	60
E- 91		45	125	20	1	60
E- 93		50	130	30	1	70
E- 96		60	150	20	3	70
E- 97		55	150	30	1	100
E- 99		50	140	30	1	50
E-100		60	150	40	2	60
E-101		50	155	30	-1	80
E-103		30	120	20	1	80
E-105		65	140	30	1	100
E-106		50	125	30	1	120
E-109		60	125	20	1	200
E-110		5	75	10	1	190
E-111		10	100	20	3	120
E-112		60	80	20	3	430
E-113		95	250	40	3	190
E-114		85	225	40	5	120
E-115		90	225	40	3	120
E-116		50	100	40	1	640
E-117		90	160	40	1	260
E-118		80	105	30	1	170
E-119		80	165	30	1	250
E-120		80	150	30	1	190
W- 68	2	30	110	20	1	70
W- 69	0	80	120	20	2	70
W- 70	2	80	135	30	1	80
W- 71	0	80	165	30	2	90
W- 72	0	65	175	20	1	60
W- 73	1	75	185	40	3	210
W- 74	2	70	145	30	2	60
W- 75	0	50	135	50	2	40
W- 76	2	85	250	30	1	60
W- 77	0	60	275	30	3	150
W- 78	1	40	145	20	-1	120
W- 79	3	30	85	20	1	190
W- 80	2	40	110	20	-1	100
W- 81	2	35	105	20	1	140
W- 82	0	35	85	20	1	120
W- 83	2	35	95	20	1	100
W- 84	1	40	110	20	1	60

Sample No.	Ml Dye	ppm Copper	ppm Zinc	ppm Lead	ppm Molybdenum	ppb Mercury
Lake Kulik General Area						
J-128		25	55	10	-1	50
J-129		30	90	30	-1	60
E-121		45	90	20	-1	100
E-122		40	100	30	1	70
E-123		40	95	30	1	100
E-124		30	90	20	-1	70
E-125		40	125	20	-1	80
E-126		35	90	20	-1	60
E-127		30	90	20	-1	60
E-128		30	85	20	1	80
E-129		35	75	20	1	70
E-130		30	85	20	-1	80
E-131		40	100	20	-1	60
E-132		30	95	20	1	120
E-133		30	95	20	1	80
E-134		60	110	20	1	140
E-135		50	100	20	-1	130
E-136		40	100	20	1	100
E-137		35	105	20	1	100
E-138		40	120	20	-1	190
E-139		40	95	20	-1	130
E-140		40	95	20	-1	80
E-141		40	105	20	-1	140
E-142		60	110	30	-1	120
E-143		70	125	30	1	130
E-144		50	105	20	-1	100
E-145		45	95	30	1	100
E-146		60	120	40	1	100
E-147		60	125	40	1	200
E-148		40	80	30	1	210
E-149		50	95	40	-1	120
E-152		60	115	30	1	80
W- 85		30	110	20	1	220
W- 86		50	120	30	1	80
W- 87		50	125	50	1	100
W- 88		30	95	20	1	40
W- 89		35	95	20	-1	40
W- 90		40	115	20	1	120
W- 91		45	95	20	1	70
W- 92		40	95	20	3	60
W- 93		20	170	20	-1	210
W- 94		60	140	20	1	100
W- 95		35	125	30	1	90
W- 96		30	130	20	2	60
W- 98		30	120	20	1	90
W- 99		30	95	20	1	80

Sample No.	Ml Dye	ppm Copper	ppm Zinc	ppm Lead	ppm Molybdenum	ppb Mercury
Nuyakuk Lake General Area						
E-155		65	120	30	1	100
E-156		70	250	30	4	200
E-160		70	250	30	1	200
E-161		70	115	30	1	140
W-100	0	60	115	20	1	590
W-101	4	70	130	20	2	120
W-102	2	90	155	30	1	190
W-103	2	90	135	20	2	70
W-104	1	70	125	20	1	130
W-105	1	55	95	20	1	60
W-106	4	80	140	20	1	280
W-107	2	60	115	20	2	70
W-108	0	80	140	30	1	80
W-109	0	70	155	30	1	80
W-110	0	75	135	20	-1	30
W-111	0	95	120	20	-1	180
W-112	0	95	145	20	1	240
W-113	1	60	100	20	1	110
W-114	1	45	85	20	1	120
W-115	1	45	85	20	1	70
W-116	3	80	160	30	1	100
W-117	1	65	130	30	1	80
W-118	1	70	125	30	1	60
W-119	1	65	160	30	1	120
W-120	2	65	130	30	1	80
W-121	3	60	140	30	2	70
W-122	3	60	155	20	1	100
W-123	1	60	110	20	1	90