STATE OF ALASKA

William A. Egan - Governor

DEPARTMENT OF NATURAL RESOURCES

Phil R. Holdsworth - Commissioner

DIVISION OF MINES AND MINERALS

James A. Williams, Director

GEOCHEMICAL REPORT NO. 10

A Geochemical Investigation of the Nenana Highway Area

By

Willow M. Burand

Juneau, Alaska
April, 1966

Tables

Figures

A GEOCHEMICAL INVESTIGATION OF THE NENANA HIGHWAY AREA

By

Willow M. Burand

ABSTRACT

A geochemical investigation of stream sediments in the Nenana Highway area was made during the summer of 1965. Five of the 62 sediment samples taken carried anomalous amounts of metals.

INTRODUCTION

A geochemical investigation of stream sediments accessible from the Fairbanks-Nenana road was made during June 1 through June 20, 1965 by the author as a part of the Division of Mines and Minerals program of mapping the geochemistry of stream sediments throughout the State. The data and other pertinent information resulting from this investigation are presented in this report.

GENERAL FEATURES

The Nenana Highway area is in interior Alaska in the northern part of the Fairbanks quadrangle. It is comprised of the lands that lie southwest of College and northeast of Nenana, bounded on the north by Goldstream Valley, and on the south by the Tanana River. The area is accessible by road from Fairbanks via College and Ester to Nenana. From Ester the road follows the southwest trending Tanana-Goldstream divide to Little Gold Stream Creek. It crosses the creek at the edge of the Tanana-Goldstream flats, and continues along the southeastern edge of the flats to the banks of the Tanana River opposite the Village of Nenana.

The climate is subarctic and semiarid, having long cold winters and relatively dry, warm, short summers. Annual precipitation varies from 12 to 18 inches, much of which falls as rain during June, July and August. Less than half of the annual precipitation is in the form of snow. Annual snowfalls may vary from 40 to 100 inches, but contain very little moisture; it takes nearly 13½ inches of snow to yield one inch of water.

The Tanana River flows in a broad alluvium filled valley that ranges in elevation from approximately 440 feet near Fairbanks to 357 feet at Nenana. The valley walls rise quite rapidly to the north in a series of fairly steep slopes to the crest of the Tanana-Goldstream Valley divide. The divide ranges in elevation from a low of approximately 800 feet to 2,364 feet on top of Ester Dome.

The divide is incised by many streams that flow through valleys, which, for about a mile from their heads, are steep-walled and narrow. There they flatten in grade, becoming broad, flat, and filled with alluvium. The streams are often dry in their upper reaches, except after rains or during spring runoffs, and many of the channels are ill defined or missing where the water flows downslope through grass, moss, and brush into the lower valley. Some of the lower valleys contain lakes, ponds, and marshes or muskegs which are at times impossible to traverse.

White spruce, white birch, and aspen grow nearly everywhere on the divide along its upper slopes, in the upper valleys, and along the courses of major streams. Marketable stands of white spruce grow locally; white birch and aspen grow most profusely in old burned over forested areas. Willow and alder grow in moist places along the slopes of the hills, in the valleys along streams, around lakes and ponds, and in marshes where favorable conditions exist. Dwarf black birch, blueberrys, low bush and high bush cranberry are abundant locally. Permafrost areas and muskegs are generally covered with thick mats of sphagnum moss, grass tussocks, and poor, straggly stands of black spruce. The sphagnum moss is the most prevalent type of vegetation -- it is found nearly everywhere growing separately and inter-growing with timber, brush, and most other kinds of vegetation.

HISTORY

The City of Fairbanks, named in honor of Senator C.W. Fairbanks -- later Vice President of the United States -- grew up around the site of a trading post, established in 1901, along the banks of the Chena River. The Fairbanks Mining District stemmed from the discovery of gold by Felix Pedro in 1902 on the creek that now bears his name.

Ester Creek, located in the northeastern part of the Nenana Highway area, was staked in 1903. However, it received very little attention from local prospectors until after coarse gold was found there in 1904. Prospectors then flocked into the area and soon developed it into one of the most productive placer gold mining camps in the Fairbanks Mining District. The area continued to be an important producer of placer gold until late in 1963, when the United States Smelting, Refining, and Mining Company shut down its Ester dredge.

GEOLOGY

The following description of the geology of the Nenana Highway area has been taken from field observations and two United States Geological Survey bulletins: (1) LODE DEPOSITS OF THE FAIRBANKS DISTRICT by James M. Hill, 849-B, published in 1933, and (2) THE YUKON-TANANA REGION, ALASKA, by J.B. Mertie, Jr., 872, published in 1937.

The bedrock of the area is mostly Birch Creek schist of pre-Cambrian age (?), undifferentiated sedimentary rocks, and acidic igneous rocks of Mesozoic age(?). The acid igneous rocks of the area are found in the vicinity of Ester Dome.

The Birch Creek schists have been exposed to long periods of widespread folding and faulting, and intrusive action. These schists are comprised mostly of highly altered sediments, consisting of quartz-mica, carbonaceous and graphitic schists, quartzites, and thin beds of impure, highly altered limestones. Intimately associated with these schists are many meta-igneous rocks, including granitic and dioritic gneisses, amphibolite and hornblende schists, and sericite and chlorite schists; all of these have been affected by the diastrophism affecting the sedimentary schists.

Fissure type quartz veins cut the schists throughout the area. Some of these in the Ester Dome area are auriferous and in places contain minor amounts of sulfides. These veins range from a fraction of an inch to over a foot in width. They are comprised of two distinct types that developed during two separate but long periods of quartz infiltration. The older veins have been crushed and contain openings subsequent to crushing, while the younger veins contain either a glassy quartz with well-formed quartz crystals, or else are rather fine-grained and grayish-white in color. Sulfides, where present, occur predominantly along the walls parallel to the veins and between the well-formed quartz crystals. Many of the grayish-white, fine-grained quartz veins contain gold intimately associated with sulfides, but in places the gold occurs without sulfides. Sulfides of iron, lead, antimony, and silver occur but not in economic quantities. Near the surface the auriferous veins are often stained or heavily coated with red limonite, the product of weathered sulfides in the rocks.

Most of the country is covered with a heavy layer of vegetation or alluvium; in only a few places do the streams cut through the vegetation and overburden deeply enough to expose the bedrock. Except for a few isolated outcrops, bedrock is exposed only in road cuts and gravel pits. Where the schists have been exposed along the road, they are in places cut by both the younger and older quartz veins, some of which contain minor amounts of sulfides. A stringer of stibnite has been exposed in one of the road cuts, but elsewhere the sulfides appear to be principally iron pyrites.

The unconsolidated deposits of the Ester Creek area are comprised of silt, sand and gravel that fall into two general groups: those that belong to ancient streams and those that are a product of the present streams. The ancient deposits are found either on terraces or benches at elevations of 500 or 600 feet, or buried beneath the alluvium. Some of these alluvial deposits are thick; the cross section of the hill between Ester and Cripple Creeks include approximately 134 feet of silt, about 5 feet of quicksand, and 35 feet of gravel. The alluvial deposits of the Ester Creek Valley are usually less than 100 feet thick. The unconsolidated deposits along the Nenana

Highway, south and west of Ester Dome, are probably composed, in part, of both ancient and recent deposits of alluvium. The recent deposits of alluvium, may in places overlie the sands, gravels, silts, and clays of ancient streams as some of the valleys appear to be too large for the streams that occupy them. Colluvium deposits occur along the base of the steep slopes of the divide and upper valleys of tributary streams incising the divide. Permafrost occurs discontinuously throughout the area.

GEOCHEMICAL STUDIES

Sixty-two field tests were made on drainage and stream sediments for cold-extractable heavy metals using the method outlined in the University of Alaska's Mining Extension Bulletin #2, ELEMENTARY GEOCHEMICAL PROSPECTING METHODS, by Leo Mark Anthony. Sediment samples were collected from each field test site, dried, screened to minus-80 mesh, and sent to Rocky Mountain Geochemical Laboratories, Salt Lake City, Utah, for analysis of trace quantities of copper, lead, zinc, and molybdenum.

The data from field tests and geochemical analyses of stream sediment samples are recorded in Table 1. Frequency distribution graphs for copper, lead, zinc, and molybdenum have been prepared from data in Table 1. These graphs show, in parts per million, the relative metal concentrations; the modes or metal concentrations that occur most frequently; and the anomalies or metal concentrations great enough to be considered indicative of a mineralized zone or area.

Five samples were found to contain anomalous amounts of metal: sample 3 was anomalous in both copper and zinc; samples 4 and 61 were anomalous in copper; sample 20 was anomalous in lead; and sample 62 was anomalous in zinc with near anomalous amounts of copper. Field tests made on samples 3, 4, and 62 required five or more milliliters of dye solution and indicate a relatively high ratio of cold-extractable to total extractable metals; whereas, field tests made on samples 20 and 61 required less than two milliliters of dye solution and indicate a relatively low ratio of cold-extractable to total extractable metals.

DISCUSSION OF RESULTS

An anomaly in a stream sediment does not necessarily indicate that an ore deposit is present upstream. It may indicate a high metal content in the country rock, or a deposit too low-grade or too small to be mined. A high metal content in a stream sediment can also be caused by excessive leaching of a weakly mineralized zone by ground waters upstream from the sample site. The intensity of an anomaly in a stream sediment or in a drainage area is a function of the total amount of metal that has been leached from the catchment basin minus the amount that has been precipitated before the ground water enters the surface drainage.

A high ratio of cold-extractable to total extractable metal may indicate a hydromorphic anomaly 1/; that is, an anomaly caused by leaching of metal from a mineralized zone and the transportation and precipitation of that metal in the soil and stream bed. A low cold-extractable to total extractable metal ratio may indicate a residual anomaly 1/; that is, an anomaly caused by the mechanical erosion of a mineralized zone and the dispersion of the metal without leaching.

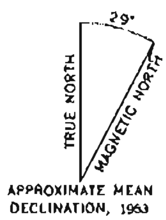
Samples 3 and 4 were taken from streams draining a marsh area below Chena Ridge and appear to be hydromorphic anomalies. Follow-up work on these should include stream sediment field tests and soil sampling with laboratory checks on at least a few of the sediment samples. Sample 20 is anomalous in lead and is probably a residual type of anomaly. It may be caused from the presence of a small vein, similar to those found on Ester Dome. Follow-up work should include laboratory tests of the stream sediments with geochemical tests then being made of the soils in the area above the last sediment sample to contain significant amounts of lead in it. Some of these soil samples should probably be checked by laboratory methods. Sample 61 was anomalous in copper and sample 62 was anomalous in zinc but also had near-anomalous amounts of copper. Follow-up work should be similar to that for sample 20.

1/ GEOCHEMISTRY IN MINERAL EXPLORATION by H.E. Hawkes and J.S. Webb, copyright 1962, p. 276.

TABLE I
NENANA HIGHWAY AREA

Sample Numbers		Field Test	Parts per Million			
Map	Field	ml of Dye	Copper	Lead	Zinc	Molybdenum
1	5K- 1	3	15	10	40	2
2	5K- 7	3	15	10	40	2
3	5K- 9	20	50	20	105	2
4	5K- 8	20	45	15	80	2
5	5K- 13	2	15	15	50	2
6	5K- 14	9	20	10	50	3
7	5K- 34	1	15	10	50	2
8	5K- 28	2	15	10	45	4
9	5K- 29	2	15	20	50	3
10	5K- 16	3	20	10	40	3
11	5K- 15	1	5	5	35	3
12	5K- 33	6	20	10	65	3
13	5K- 31	2	15	10	50	3
14	5K- 32	2	5	5	40	2
15	5K- 33	12	15	10	50	3
16	5K- 10	17	20	10	45	2
17	5K- 11	20	20	10	50	2
18	5K- 12	20	20	10	45	3
19	5K- 17	2	20	10	50	3
20	5K- 18	2	25	50	70	2
21	5K- 19	2	10	10	50	2
22	5K- 20	2	20	10	50	3
23	5K- 21	2	10	10	45	3
24	5K- 24	4	10	10	50	3
25	5K- 25	19	15	10	50	3
26	5K- 26	5	5	10	40	3
27	5K- 27	5	5	10	35	3
28	5K- 23	2	20	10	60	3
29	5K- 22	18	20	10	60	3
30	5K- 37	13	10	10	55	3

31	5K- 38	7	30	15	60	3
32	5K- 36	1	10	10	50	3
33	5K- 35	2	5	5	50	2
34	5K- 39	19	10	10	45	2
35	5K- 40	3	20	10	50	3
36	5K- 51	19	20	10	55	3
37	5K- 50	2	20	15	60	3
38	5K- 52	1	10	10	60	2
39	5K- 53	20	15	10	50	1
40	5K- 54	20	15	10	50	3
41	5K- 55	19	20	10	50	3
42	5K- 56	12	25	10	55	3
43	5K- 57	2	15	10	55	2
44	5K- 58	5	15	15	60	3
45	5K- 59	16	10	10	50	3
46	5K- 60	20	15	10	55	2
47	5K- 61	20	10	10	50	2
48	5K- 62B	10	20	10	65	4
49	5K- 62A	10	15	10	60	2
50	5K- 41	20	5	10	45	4
51	5K- 47	10	5	10	50	3
52	5K- 46	1	20	20	80	3
53	5K- 45	1	15	10	50	2
54	5K- 44	20	10	10	50	3
55	5K- 43	3	5	10	50	3
56	5K- 42	20	15	10	60	2
57	5K- 6	15	20	10	40	2
58	5K- 49	16	10	10	40	3
59	5K- 5	4	15	10	50	2
60	5K- 4	2	20	10	45	3
61	5K- 3	1	45	15	65	2
62	5K- 2	5	35	15	100	2



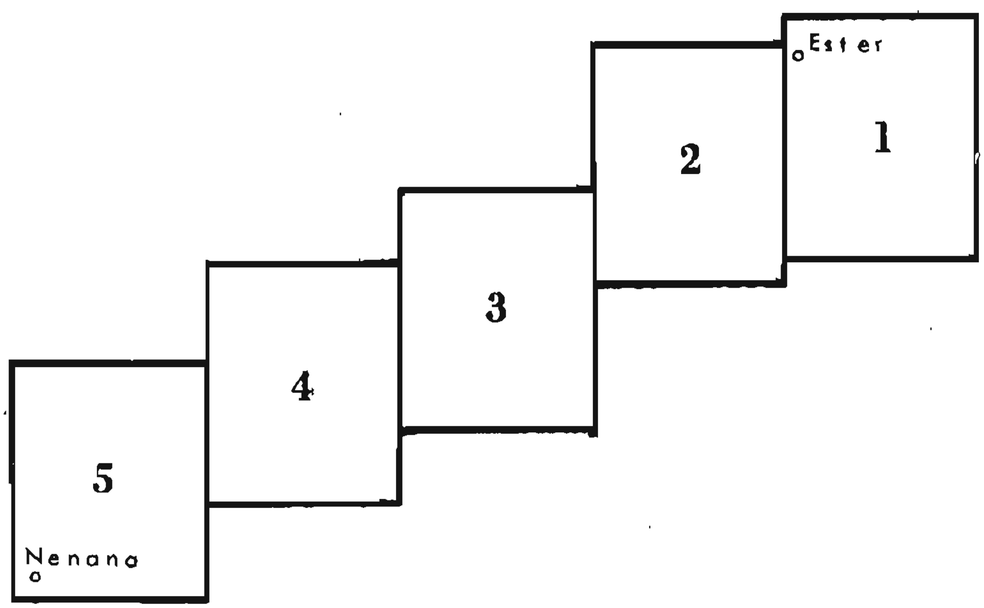


DIAGRAM
Showing Layout of
Figs. 1 — 5

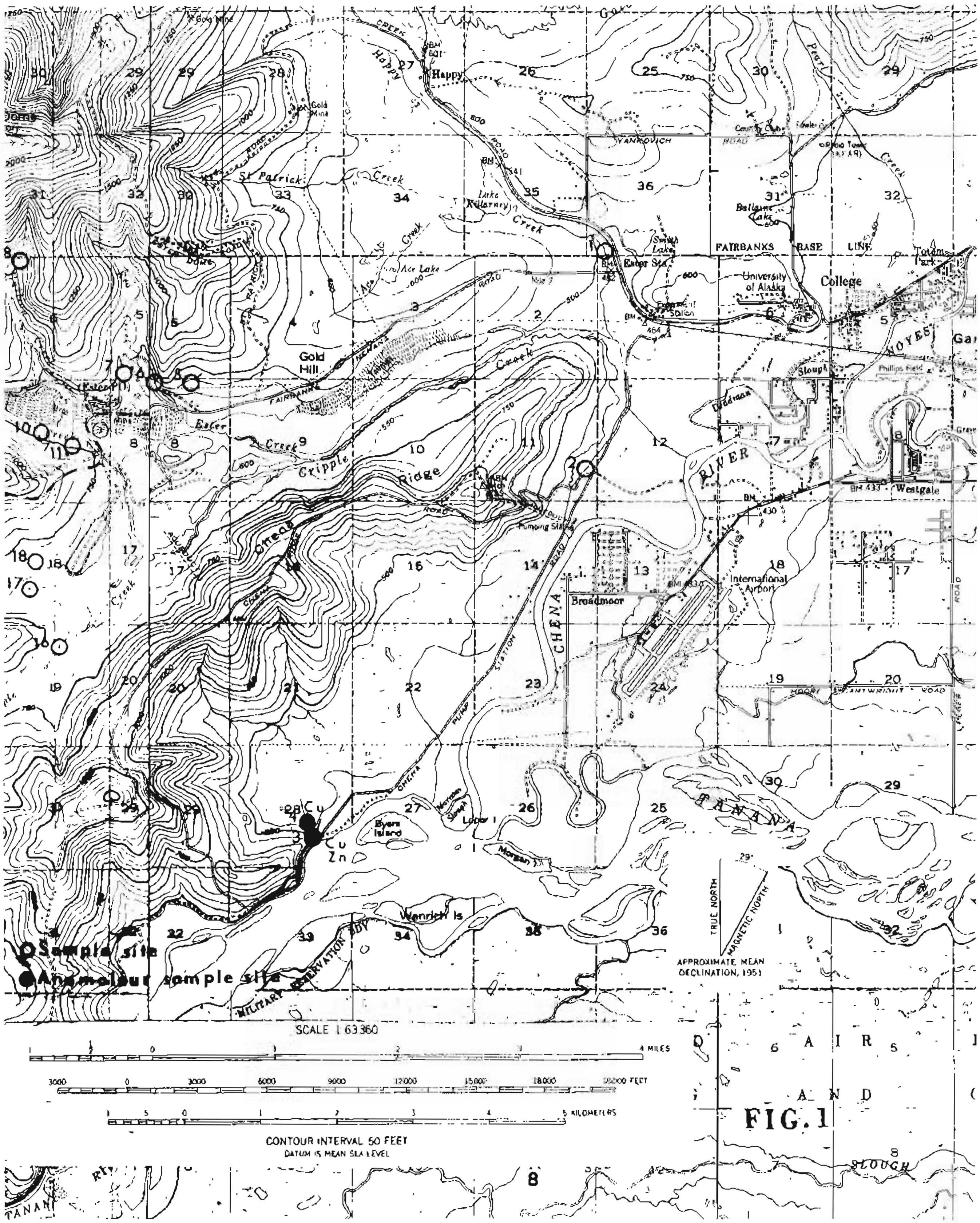

Sample site
Anomalous sample site
SCALE 1:63360
4 MILES
3000 0 3000 6000 9000 12000 15000 18000 21000 FEET
5 KILOMETERS
CONTOUR INTERVAL 50 FEET
DATUM IS MEAN SEA LEVEL
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1951
Happy
Gold Hill
Ester
Cripple Creek
St Patrick Creek
Lake Killarney
FAIRBANKS BASE LINE
University of Alaska
College
Broadmoor
International Airport
Westgate
CHENA RIVER
Chena Ridge
Chena Pump Road
Byers Island
Wenrich Is
Morgan
MILITARY RESERVATION BDY
Cu
Zn

FIG. 1

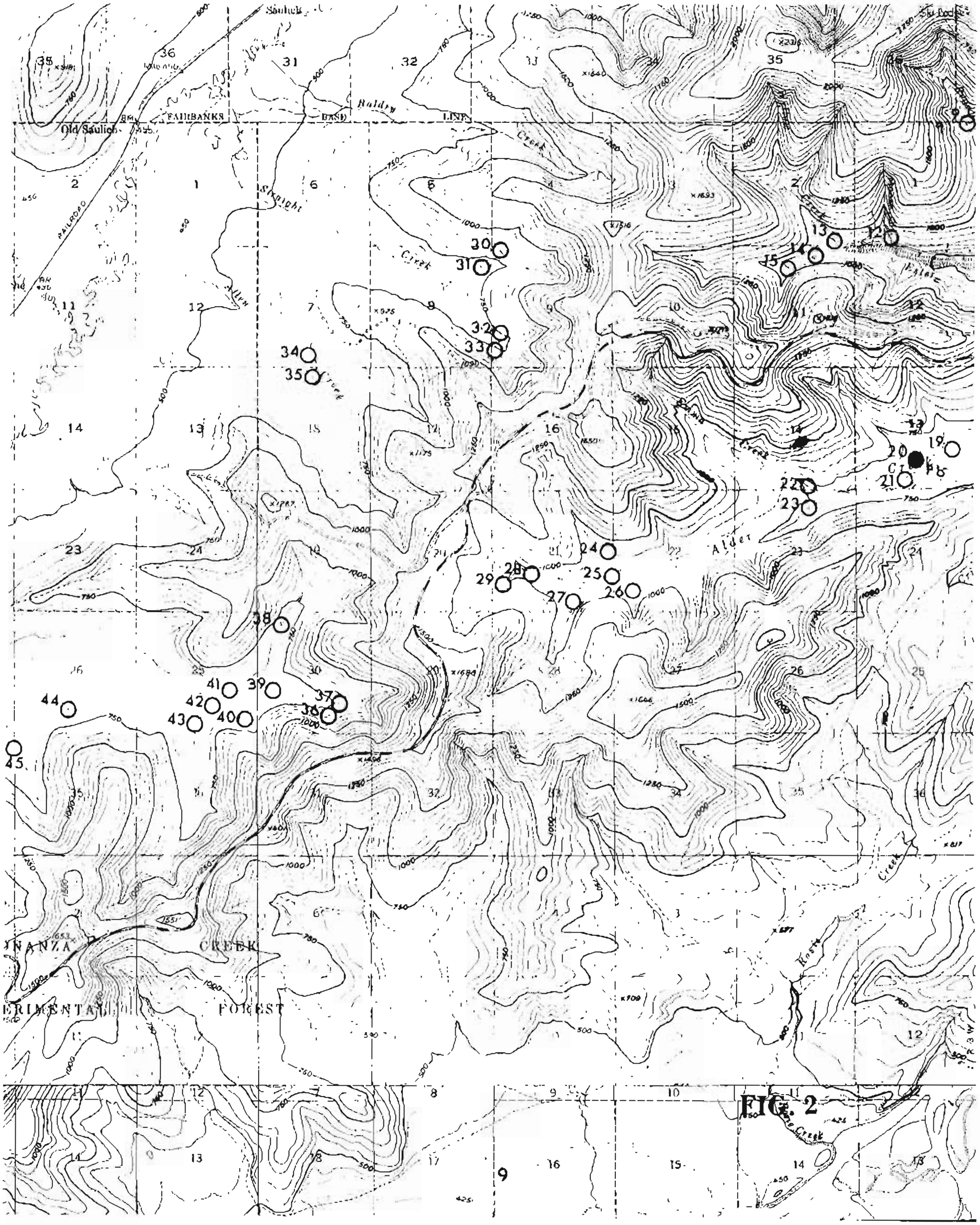

Old Saulich
FAIRBANKS
BASE
LINE
Baldry
Creek
Straight
Creek
RAILROAD
Alder
Creek
BONANZA
CREEK
EXPERIMENTAL
FOREST
Ski Lodge
Kosty
Creek

FIG. 2

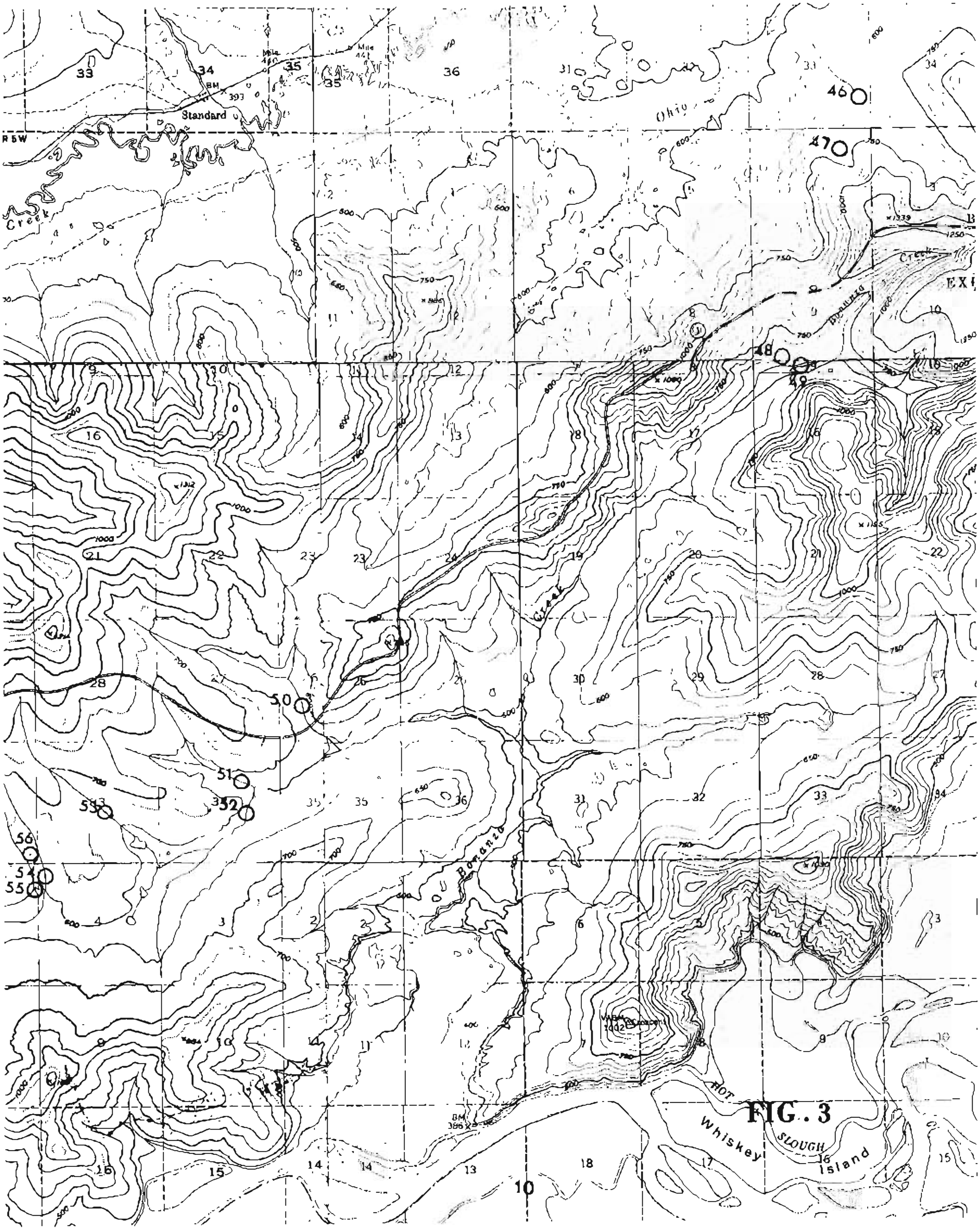

Standard
Creek
Ohio
Bonanza
Creek
Whiskey
Island
HOT SLOUGH
46
47
48
49
50
51
52
53
54
55
56

FIG. 3

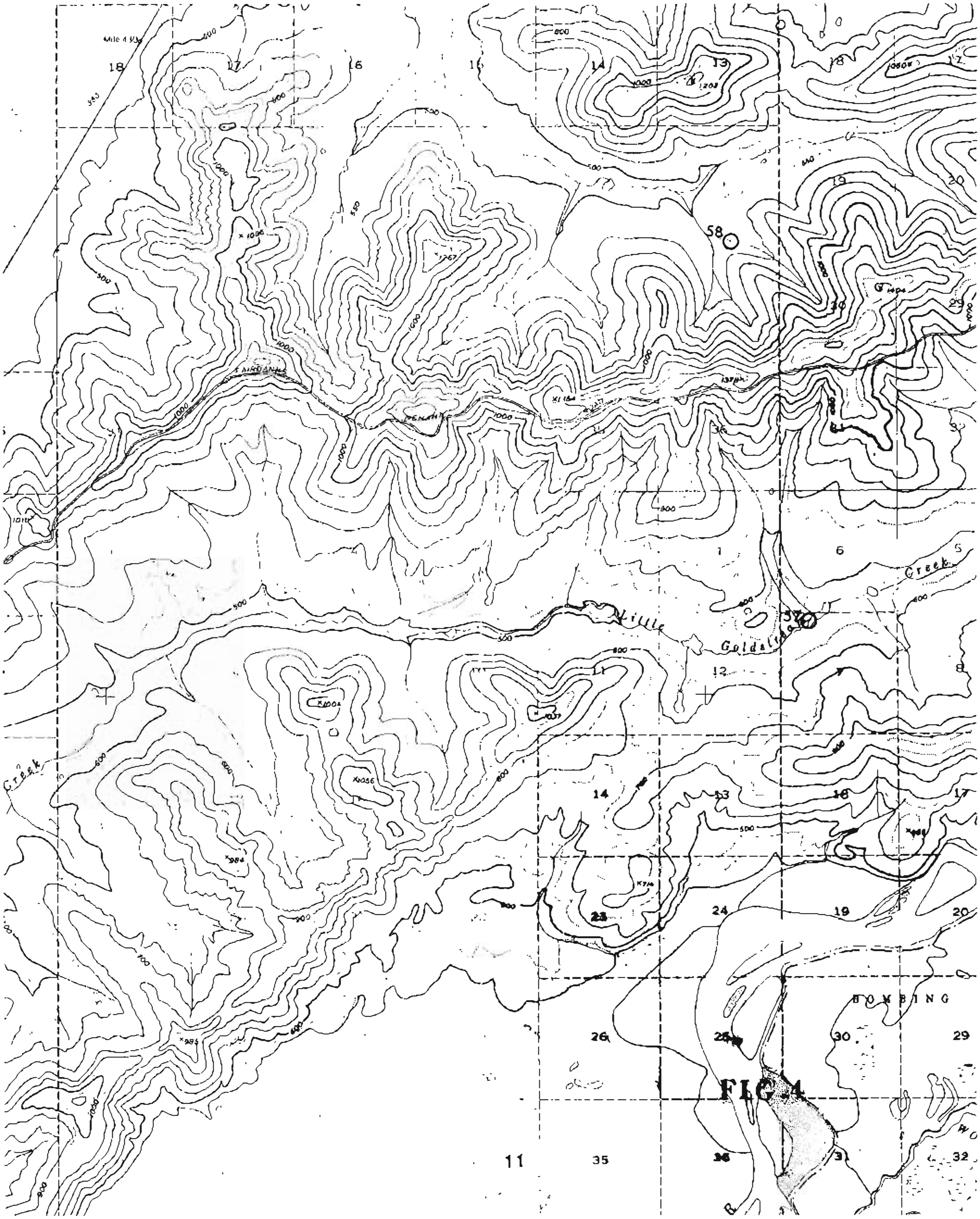
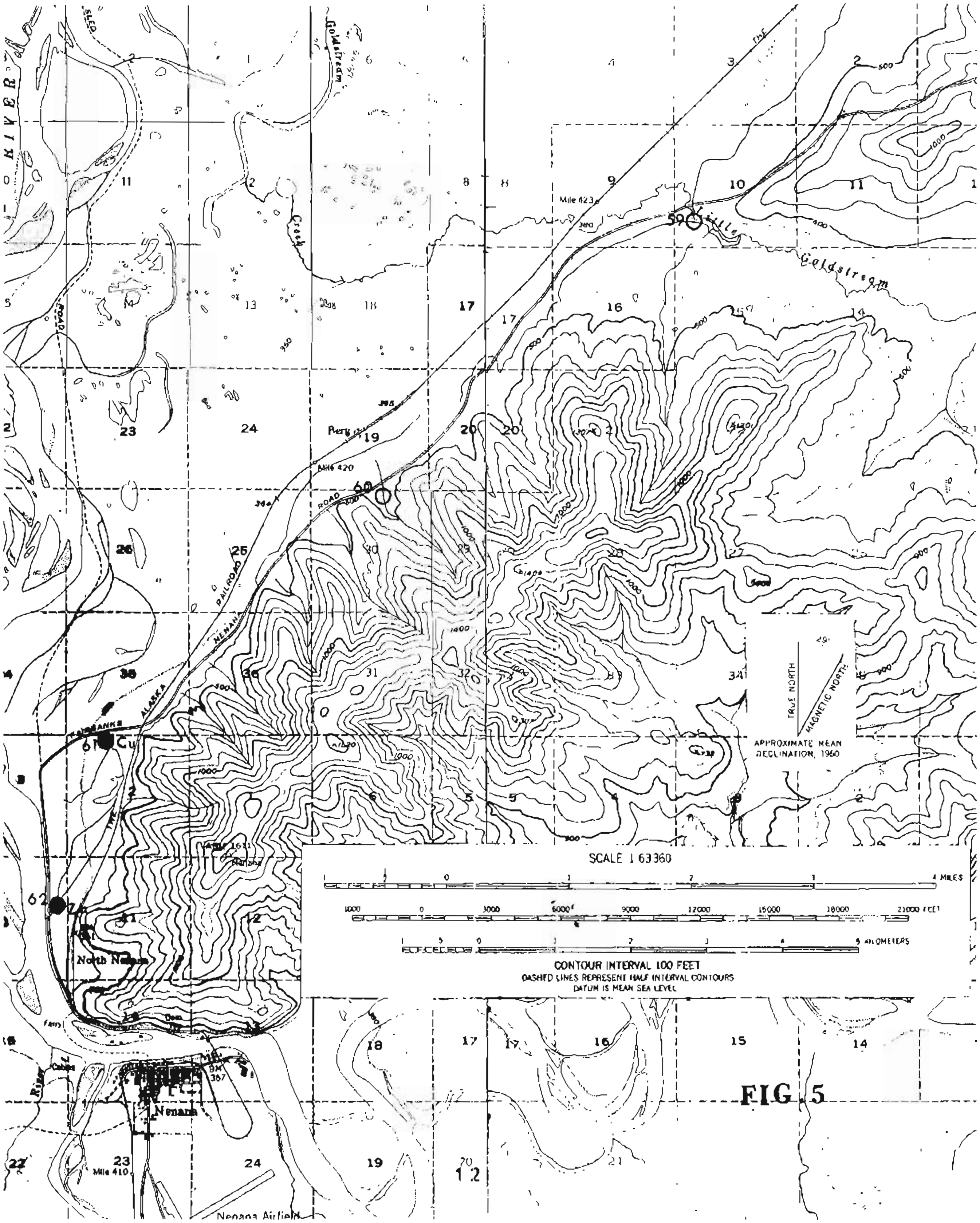


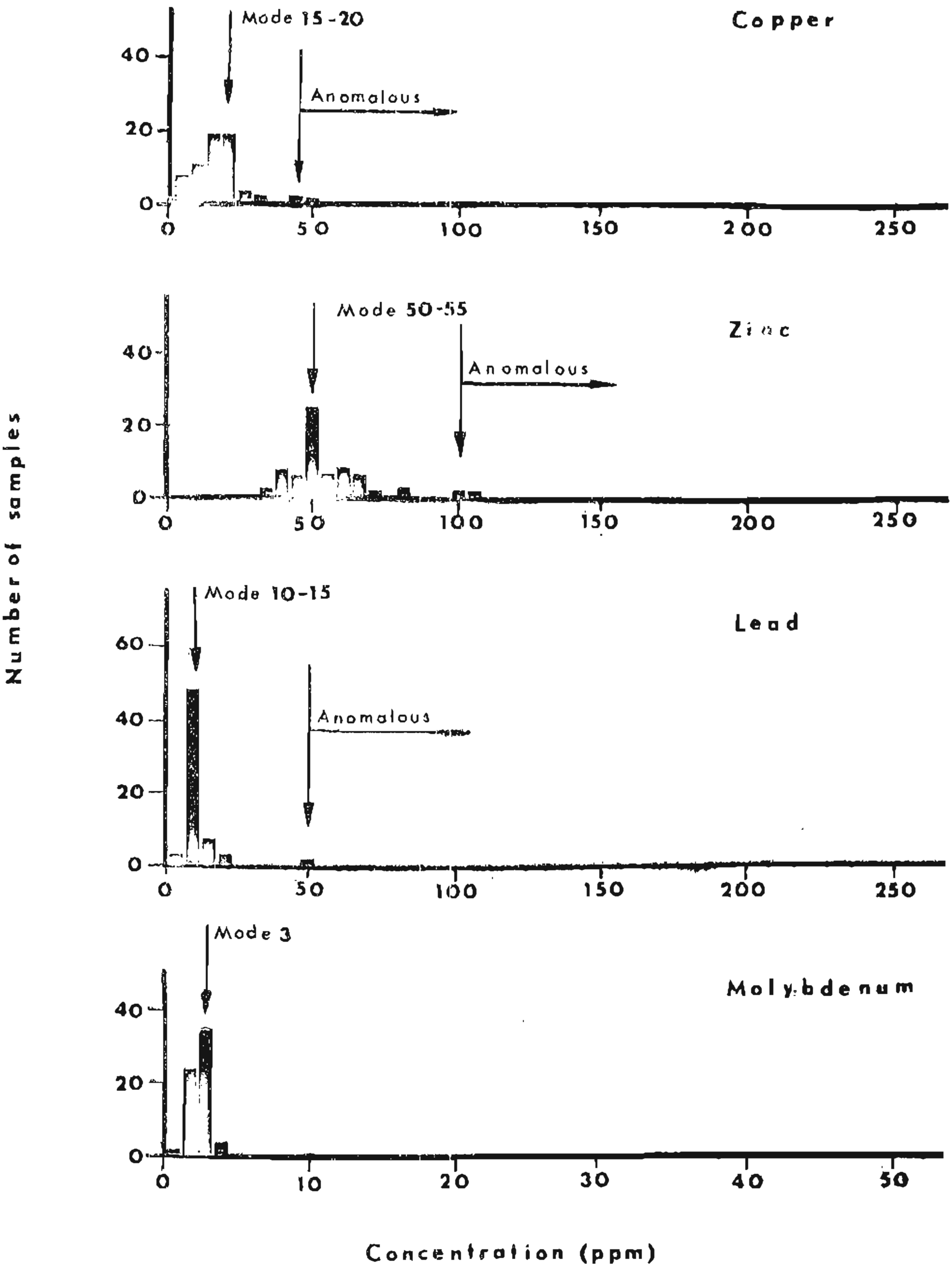
FIG. 4



RIVER
Goldstream
Creek
Little Goldstream
Mile 423
Mile 420
Mile 410
ROAD
ALASKA RAILROAD
NENANA
FAIRBANKS
North Nenana
Nenana
Nenana Airfield
Ferry
Cu
SCALE 1:63360
4 MILES
21000 FEET
5 KILOMETERS
CONTOUR INTERVAL 100 FEET
DASHED LINES REPRESENT HALF INTERVAL CONTOURS
DATUM IS MEAN SEA LEVEL
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1960

FIG. 5

12



Frequency distribution graphs for copper, zinc, lead, and molybdenum in stream sediments in the Nenana Highway area.