STATE OF ALASKA

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Geochemical Report No. 15

Geochemical Investigations Along the Valdez to Chitina Highway in Southcentral Alaska, 1966

By

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GEOCHEMICAL INVESTIGATIONS ALONG THE VALDEZ TO CHITINA HIGHWAY IN SOUTHCENTRAL ALASKA, 1966

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SUMMARY

Results of the 1966 stream sediment sampling program in the readily accessible areas along the 120 miles of the Valdez to Chitina highway revealed no outstanding anomalies. Of the 102 samples taken, 12 were "border-line" anomalies, and the balance of them were below the anomalous range.

Prospectors have covered the report area for 68 years, but to date have made no discoveries that have proven to be of economic importance.

Revived interest has been shown in the long-known chromite area situated on Red Mountain about five miles east of Mile 70 on the Richardson Highway. A large number of claims were staked covering the occurrences in 1966, and an exploration program is planned for the property during the 1967 season. The chief interest in this prospect is reported to be minerals other than chromite.

Interest has recently been shown in the long-known copper occurrences on the east side of the Copper River, between Canyon Creek and the mouth of Chitina River in the Chitina area. Thorough prospecting in this locality has been retarded due to its being relatively difficult of access. Old reports suggest the possibility of there being a substantial low-grade copper distribution in that locality. During the past season, several prospectors spent some time in this area.

INTRODUCTION

The geochemical stream sediment sampling program was continued during the 1966 field season by the Division of Mines and Minerals in the search for trace amounts of metallic minerals (copper, lead, zinc, molybdenum, and nickel) which might lead to the location of hidden ore deposits. This program is for the benefit of prospectors and others interested in mineral exploration.

This report covers 102 samples taken by Jasper (97 in 1966 and 5 in 1965) from accessible streams along the Valdez to Chitina highway system. Sample locations are shown on figures 1 to 10.

With the recently renewed interest and increasing demands for uranium, all samples were checked for radioactivity with a geiger counter, but none was found.

Microscopic studies of the very samll amounts of concentrates in the samples were also made.

TOPOGRAPHY

In the area between Valdez and Tonsina Lodge at Mile 75, the topography is mostly one of steep slopes with serrated ridges in some areas and well-rounded summits in other sections. Elevations range from sea level at Valdez to 2,730 feet in Thompson Pass to 7,280 feet a few miles off the highway. Numerous glaciers and glacier remnants are visible between Keystone Canyon and Tiekel. Between Tiekel and Chitina the topography is less rugged with maximum elevations of 6,000 feet, although the mountains generally have fairly steep slopes.

GENERAL GEOLOGY

Bedrock in the Valdez to upper Tonsina district is almost entirely confined to the Valdez Group (late Cretaceous?), which has an easterly-westerly trend, and outcrop exposures are approximately 60 miles wide across its regional strike. In the Valdez (A-5) quadrangle it is almost entirely dark gray, very fine-grained foliated phyllitic graywacke, containing countless thin discontinuous quartz veinlets paralleling the foliation (Coulter and Coulter, 1961). This rock type extends to the east and west for many miles.

A small sill of intruded monzonite is exposed along the south side of Worthington Glacier at the 3,700 foot elevation in the Valdez (A-5) quadrangle. The sill is exposed for over 500 feet and has a two to four foot width. A quartz monzonite dike of four foot width and exposed for 800 feet, has a N.15°E. strike and steep dip (Coulter and Coulter, 1961).

Attention is called to the fact that in all locations of the Tonsina district where gold-quartz has been found, the slate and graywacke formations are cut by dikes and sills of quartz diorite or granite, which suggests genetic relationship of the gold-quartz veins with the intrusives (Moffit, 1935).

The gold content in the quartz veins appear to be related to the abundance of galena, sphalerite, arsenopyrite, chalcopyrite and pyrite - that is, the more sulfides present, the higher the gold content. None of these minerals, however, are sufficiently abundant to be of economic interest.

Between the Tsina River bridge north to Tiekel, the area appears limited to the Valdez Group formation (Moffit, 1935).

The highway section between Tiekel and the Tonsina Roadhouse at Mile 75 is largely confined to the same bedrock type. The chromite occurrences situated on Red Mountain, about four miles east of Mile 70, however, suggest that ultramafic formations underlie a substantial area in that vicinity.

In the Chitina district, between O'Brien Creek and Lower Tonsina, the Strelna greenstone formation is predominent on the west side of the Copper River, with some graywacke and/or argillite in the vicinity of Liberty Falls, and a red lava at two points a few miles northwest of the falls. On the east side of the Copper River, between Canyon Creek and the mouth of the Chitina River, the Strelna greenstone and diorite predominate and intrude the older graywacke (Moffit, 1911).

MINERAL DEPOSITS

With Valdez a port of entry for overland travel to the Fairbanks region since 1898, it is certain that during the past 68 years thorough search has been made for exposed mineral occurrences of possible economic importance.

Original interest of prospectors in the Prince William Sound region was largely centered on the search for copper and gold, with a number of important copper deposits being discovered and mined.

The discovery of high-grade gold-quartz veins at the Cliff mine in the Valdez district in 1910 resulted in the search for and discovery of other gold-quartz occurrences of interest in that vicinity (Johnson, 1915). The primary interest of prospectors was then shifted to the search for gold placer and gold-quartz, as well as other metals, in the Valdez to Chitina region, which covered the areas accessible to the highway.

In 1915 a copper lode was reported to have been found on the south side of the Lowe River about 15 miles east of Valdez. Its exact location is not known (Johnson, 1915). The same publication mentions the old Addison Powell property, a reputed low-grade copper prospect situated at the head of Sulphide Gulch about four miles south of the highway at Mile 10. Its discovery was several years prior to 1915, and was abandoned a few years later with no serious interest known to have been shown in the prospect since then.

Of the many quartz veins found and prospected between Keystone Canyon and the Tonsina Lodge at Mile 75, those discovered and believed to have had the most promise and the most work done on them, are located in the Tiekel district. These gold-quartz vein locations include:

1. Hurtle Creek, tributary to Tonsina Lake. Several groups of lode claims were staked in this drainage area with the Wetzler property considered to be the most promising. In addition to gold, the veins contain some galena, sphalerite, arsenopyrite, chalcopyrite, and pyrite. No appreciable production is known, although considerable development work was done on the several known veins (Moffit, 1935).

2. Boulder Creek, tributary to Tiekel River. Several discoveries of high-grade gold-bearing quartz aroused interest in this prospect known as the "Ellis" property. Mineralization is limited to free gold and small amounts of galena and arsenopyrite. Gold was recovered with quicksilver in an arrastre, and production appears to have been between $10,000 and $20,000. This is reported to have been the only gold production from the gold-quartz properties in the Tiekel area (Moffit, 1935).

3. Stuart Creek, tributary to Tsina River. Gold-bearing quartz veins were discovered in 1923 near the head of Mill Creek, a tributary of Stuart Creek, and were held by M. J. Knowles up to 1935. Numerous narrow quartz veins carry a little gold with small amounts of galena and pyrite. Development on the property was limited to open cuts (Moffit, 1935).

4. Fall Creek, tributary to Tiekel River. Placer mining along this stream was carried on for several years prior to 1916, but the venture proved unprofitable and was abandoned (Moffit, 1935).

5. A gold-quartz prospect near Mile 40 was discovered during the early days of the gold seekers in this area. More work was reported done on it than on any other prospect in the Tonsina district. Two tunnels were driven under the highway on two separate veins. One followed a three to five foot gold-quartz vein 300 feet, and the other was driven on a parallel 12-inch vein for 150 feet. It was considered a promising prospect, but no work has been done on it for many years (Moffit, 1935).

During 1965 most, if not all, of the old abandoned gold-quartz prospects in the Valdez to Tonsina Lodge region were reported by the Valdez Magistrate to have been restaked.

The long-known chromite occurrences on Red Mountain, four miles (airline) east of Mile 70 on the Richardson Highway and confined to the vicinity of Bernard Creek, are presently the only known mineral showings of definite interest along the Valdez to Tonsina road system. During 1966 a large number of claims were restaked, some surface stripping done, and tentative plans made for a development program in 1967.

In the Chitina area a manganite discovery was made in 1960. It is located on the west side of Liberty Creek, about 4,000 feet above Liberty Falls, and occurs in the Strelna greenstone formation. The discovery outcrop is a small lens about 40 feet in length, of maximum two-foot width, and terminates in small stringers at both ends. Since then, several other isolated lenses have been reported found along the formation's southerly strike for a distance of one mile or more. The outcrops are said to have widths of one to five feet; their full lengths are reported obscured by soil and talus cover, and fairly dense brush growth. Systematic sampling of the showings has not been done to determine the average grade of the manganite.

No copper showings have been reported on the west side of the Copper River between O'Brien Creek and Lower Tonsina. On the east side of the river, however, numerous scattered copper occurrences have long been known between Canyon Creek and the mouth of the Chitina River, which should be more thoroughly checked for possible low-grade disseminated type deposits of possible economic interest. Of numerous claims staked prior to 1911, only the Blakney property was patented at that time (Moffit). Very little sustained interest has been shown in this area, which is probably due to its being of somewhat difficult access.

GEOCHEMICAL FIELD INVESTIGATIONS

During the 1966 sampling, 97 samples were taken from 97 streams along the Valdez to Chitina highway. Five additional samples taken in the Chitina area in 1965 are included, making a total of 102. The Hawkes field testing method was used in checking for traces of cold extractable heavy metals (Hawkes, 1963).

Sample sites were selected well above bridges and culverts, or other known objects that could possibly contaminate the streams. Samples were taken of sediments under water and, wherever possible, included material on bedrock which generally consisted of silt, sands, and/or gravel and organic substances. Some clay was occasionally present in glacier-fed streams.

A large portion of each sample was panned at the site to obtain the heavy minerals that might be present, and the concentrates were saved for identification.

After drying each geochemical split (portion not panned) and screening it to -80 mesh, the sample was again split. One split was sent to the Rocky Mountain Geochemical Laboratories, Salt Lake City, Utah, where analyses for trace amounts (parts per million - ppm) copper, lead, zinc, molybdenum, and nickel were made. The other half was kept and filed in case future checking might be desirable.

The concentrate samples were studied under a binocular microscope, and a grain count made of the heavy metallic minerals identified. In samples containing relatively abundant magnetite, percentages of this mineral present were estimated. The amount of the heavy minerals identified is a very small fraction of each sample. A tabulation of the "grain counts" is included in tables 1 to 10.

RESULTS

For samples taken along the Valdez to Chitina highway, anomalous values used for the region were: copper, +70 ppm; lead, +30 ppm; zinc, +120 ppm, and molybdenum, +5 ppm. Few samples were checked for nickel as no ultramafic formations were noted, and no anomalies were obtained in those checked.

Laboratory results did not indicate any outstanding anomalies but did indicate several moderately anomalous areas in which further sampling may be warranted. No radioactive samples were obtained.

Of the 102 samples checked by the laboratory, the following is a list of the eight slightly anomalous samples:

		PPM			
Figure No.	Map No.	Cu	Pb	Zn	Mo
1	6	--	--	--	5
1	7	--	--	--	5
2	19	--	--	120	--
2	22	--	--	120	--
3	37	--	--	150	--
4	44	70	--	--	--
4	45	70	--	125	--
4	46	--	35	--	--

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Table 1
Results of Analyses

Map No.	Sample No.	Fig. No.	Concentration (ppm) Cu	Pb	Zn	Mo	Ni	Cx ml dye	Color Reaction	Bedrock	Creek Float	Concentrates
1	6F-128	1	40	5	80	4	30	+20	Red	Covered	Metasediments - small gravel only	-0.1% magnetite, 4gr. pyrite, 12 gr. zircon, 4gr. pyrrhotite.
2	6F-129	1	40	5	75	2	10	14	Red 6ml Purple 4ml Brown 4ml	Covered	Graywacke, argillite, little greenstone	-0.1% magnetite, 5gr. pyrite, 4gr. zircon, 2gr.scheelite.
3	6F-130	1	30	5	100	2	60	+20	Red 5ml Purple 3ml Brown+12ml	Covered	Shale, slate, and argillite -1% quartz	Few gr. magnetite, 1 gr. scheelite.
4	6F-131	1	30	10	85	2	20	14	Red 6ml Purple 4ml Brown 4ml	Covered	Metasediments, little greenstone	Few gr. magnetite, 1 gr. zircon, 1gr. scheelite.
5	6F-132	1	35	10	85	2	10	10	Pink 2ml Brown 4ml Red 4ml	Covered	Metasediments, -1% quartz	20 gr. magnetite, 5 gr. pyrite.
6	6F-133	1	25	5	70	<u>5</u>	30	4	Purple 2ml Blue-gray-2ml	Metasediments	Metasediments, -1% quartz	20 gr. magnetite.
7	6F-134	1	30	10	75	<u>5</u>	10	8	Purple 3ml Blue-gray-5ml	Metasediments	Metasediments	10 gr. magnetite, 10 gr. pyrite.
8	6F-27	2	40	20	65	4		2	Purple 1ml Blue-gray-1ml	Covered	Metasediments, little greenstone, ±1% quartz	10 gr. magnetite, 10 gr. pyrite, 2 gr. zircon, ±10 gr. pyrrhotite

Map No.	Sample No.	Fig. No.	Concentration (ppm) Cu	Pb	Zn	Mo	Ni	Cx ml dye	Color Reaction	Bedrock	Creek Float	Concentrates
9	6F-28	2	55	15	80	4		2	Purple 2ml	Slate & shale	Graywacke, slates, & little greenstone	-0.1% magnetite, 10gr. pyrite, 2gr. zircon.
10	6F-29	2	40	15	85	3		1	Purple 1ml	Metasediments	Slate, shale, graywacke, & a little greenstone	±30% magnetite, 5gr. pyrite.
11	6F-30	2	35	25	90	3		2	Pink 2ml	Covered	Metasediments, little greenstone and dike, ±2% quartz	10gr. magnetite, ±25gr. pyrite, 4gr. zircon.
12	6F-31	2	35	10	85	2		3	Pink 2ml Purple 1ml	Covered	Argillite, slate, shale, serpentized greenstone, ±1% quartz	±50gr. magnetite, 33gr. pyrite, 6 gr. pyrrhotite.
13	6F-32	2	35	10	80	2		3	Pink 2ml Purple 1ml	Covered	Serpentized greenstone, argillite, graywacke, ±2% quartz	30gr. magnetite, 22gr. pyrite, 4 gr. zircon.
14	6F-33	2	40	10	95	2		2	Pink 1ml Blue-gray-1ml	Covered	Serpentized greenstone, argillite, graywacke, ±2% quartz	±100gr. magnetite, 20gr. pyrite, 4gr. pyrrhotite.
15	6F-34	2	25	15	95	2		16	Pink 2ml Purple 4ml	Covered	Serpentized greenstone, argillite, graywacke, ±2% quartz	±100gr. magnetite, 17gr. pyrite, 3gr. zircon.
16	6F-138	2	45	15	90	4	20	4	Red 1ml Purple 3ml	Graywacke & slate	Graywacke, slate, argillite	50gr. magnetite, 10gr. pyrite, 1gr. zircon.

Map No.	Sample No.	Fig. No.	Concentration (ppm) Cu	Pb	Zn	Mo	Ni	Cx ml dye	Color Reaction	Bedrock	Creek Float	Concentrates
17	6F-139	2	20	10	80	3	50	+20	Pink 2ml Purple 8ml Blue-gray- +10ml	Graywacke, shale, and slate	Graywacke, shale, slate, little greenstone, -2% quartz	40gr. magnetite, 6gr. pyrite, 3gr. zircon.
18	6F-35	2	45	20	105	3		14	Pink 1ml Purple13ml	Graywacke, shale & slate	Graywacke,shale, slate & little greenstone	4gr. magnetite, 5gr. pyrite.
19	6F-36	2	50	20	<u>120</u>	2		8	Pink 1ml Purple 7ml	Graywacke, shale & slate	Graywacke, shale, slate & little greenstone	8gr. magnetite, 4gr. pyrite, 1gr. zircon.
20	6F-37	2	35	20	85	2		4	Yellow 4ml	Graywacke, shale & slate	Graywacke, shale, slate & little greenstone	10gr. magnetite, 5gr. pyrite, 3gr. zircon
21	6F-135	2	25	10	95	<u>5</u>	50	+20	Pink 3ml Purple +17ml	Metasediments	Graywacke, argillite, slate, and little dike	50gr. magnetite, 4gr. pyrite.
22	6F-140	2	55	10	<u>120</u>	3	90	5	Purple 5ml	Graywacke	Graywacke	none
23	6F-136	2	60	10	85	3	20	+20	Purple +20ml	Greenstone	Graywacke, argillite, slate, and little greenstone, -1% quartz	50gr. magnetite, ±38gr. pyrite.
24	6F-137	2	35	10	100	3	20	5	Pink 1ml Purple 4ml	Covered	Shale, slate, and argillite	8gr. magnetite.
25	6F-38	3	50	15	95	3		13	Purple 8ml Brown 5ml	Covered	Metasediments, and little greenstone, ±2% quartz	10gr. magnetite, 9gr. pyrite

Map No.	Sample No.	Fig. No.	Concentration (ppm) Cu	Pb	Zn	Mo	Ni	Cx ml dye	Color Reaction	Bedrock	Creek Float	Concentrates
26	6F-39	3	60	15	90	4		10	Purple 4ml Brown 6ml	Covered	Metasediments, and little greenstone, ±2% quartz	7gr. pyrite, 2gr. scheelite, 25gr. zircon.
27	6F-40	3	40	10	75	4		2	Purple 1ml Yellow 1ml	Covered	Metasediments, and little greenstone, ±2% quartz	±100gr. magnetite 3gr. pyrite, 14gr. zircon.
28	6F-41	3	30	10	70	2		1	Purple 1ml	Covered	Metasediments, and little greenstone, ±2% quartz	10gr. magnetite, 2gr. pyrite, 11gr. zircon.
29	6F-42	3	40	10	90	2		8	Purple 8ml	Covered	Metasediments, and little greenstone, ±1% quartz	5gr. magnetite, 3gr. pyrite 2gr. zircon.
30	6F-43	3	40	20	105	2		2	Pink 1ml Purple 1ml	Covered	Slate, shale, and argillite, ±1% quartz	25gr. magnetite, 3gr. pyrite.
31	6F-44	3	25	10	60	2		2	Purple 2ml	Graywacke & slate	Graywacke, argillite, slate, and little greenstone	10gr. magnetite, 2gr. pyrite, 1gr. scheelite, 30gr. zircon.
32	6F-45	3	35	15	80	2		2	Pink 1ml Purple 1ml	Graywacke & slate	Graywacke, argillite, and slate, ±2% quartz	20gr. magnetite, 4gr. pyrite, 11gr. zircon.
33	6F-46	3	30	20	80	2		3	Pink 1ml Purple 2ml	Covered	Graywacke, argillite, and slate, ±2% quartz	12gr. magnetite, 5gr. pyrite.
34	6F-47	3	35	10	95	2		2	Purple 2ml	Graywacke, shale & slate	Graywacke, argillite, and slate, ±1% quartz	15gr. magnetite, 9gr. zircon.

Map No.	Sample No.	Fig. No.	Concentration (ppm) Cu	Pb	Zn	Mo	Ni	Cx ml dye	Color Reaction	Bedrock	Creek Float	Concentrates
35	6F-48	3	45	15	80	2		2	Purple 2ml	Slate	Metasediments, ("milky" glacier-fed stream)	30gr. magnetite, 20gr. pyrite, 7gr. zircon, ±30gr. pyrrhotite.
36	6F-49	3	40	20	70	2		6	Purple 6ml	Covered	Metasediments, & greenstone schist	±60gr. magnetite, 11gr. pyrite, 10gr. zircon, 25gr. pyrrhotite.
37	6F-50	3	15	15	<u>150</u>	2		(not tested in field)		Shale, slate, and argillite,	Argillite, slate, and shale, ±2% quartz	No concentrates noted.
38	6F-51	3	35	15	110	2		2	Purple 2ml	Covered	Argillite, slate, and shale, ±2% quartz	±50gr. magnetite, ±15gr. pyrite, 6gr. zircon, 10gr. pyrrhotite.
39	6F-52	4	35	15	90	3		4	Pink 2ml Yellow 2ml	Covered	Argillite, gray-wacke, slate, little greenstone schist, -1% quartz	20gr. magnetite, 8gr. pyrrhotite.
40	6F-53	4	55	20	<u>120</u>	2		8	Pink 2ml Purple 6ml	Covered	Metasediments, -2% quartz	±200gr. magnetite, 10gr. pyrite.
41	6F-54	4	60	20	<u>120</u>	3		+20	Purple 4ml Pink 5ml Purple +11ml	Covered	Serpentized greenstone, slate, shale graywacke, -2% quartz	39gr. magnetite, 8gr. pyrite.
42	6F-55	4	65	15	<u>120</u>	2		10	Purple	Covered	Argillite, slate, graywacke,sandstone, little serpentized greenstone, -2% quartz	±120gr. magnetite, 10gr. pyrite.

Map No.	Sample No.	Fig. No.	Concentration (ppm) Cu	Pb	Zn	Mo	Ni	Cx ml dye	Color Reaction	Bedrock	Creek Float	Concentrates
43	6F-56	4	45	15	110	2		15	Red 4ml Purple 2ml Brown 9ml	Greenstone schist	Greenstone schist, -10% quartz	±170gr. magnetite, 8gr. pyrite.
44	6F-57	4	<u>70</u>	25	115	2		7	Purple	Greenstone schist	Greenstone schist, -2% quartz	3gr. magnetite.
45	6F-58	4	<u>70</u>	25	<u>125</u>	4		2	Pink 1ml Purple 1ml	Graywacke, shale & slate	Graywacke, shale, argillite, sandstone	35gr. magnetite, 5gr. pyrite.
46	6F-59	4	60	<u>35</u>	100	2		2	Pink 1ml Purple 1ml	Graywacke, shale & slate	Graywacke, argillite, slate, -10% quartz	±110gr. magnetite, 10gr. pyrite.
47	6F-60	4	20	10	70	1		2	Pink 1ml Purple 1ml	Graywacke, slate, shale, sandstone	Graywacke, argillite, slate, sandstone, ±2% quartz	±130gr. magnetite, 6gr. pyrite, 1gr. scheelite, 7gr. zircon.
48	6F-61	4	40	15	115	3		1	Pink 1ml	Graywacke, slate, shale, sandstone	Graywacke, argillite, slate, sandstone, ±2% quartz	±140gr. magnetite, 7gr. pyrite, 8gr. zircon.
49	6F-62	4	30	5	90	3		3	Pink 2ml Purple 1ml	Graywacke, slate, shale, sandstone	Graywacke, argillite, little greenstone, ±2% quartz	±115gr. magnetite, 4gr. pyrite.
50	6F-63	5	35	10	105	2		4	Pink 2ml Brown 2ml	Covered	Graywacke, argillite, little greenstone, -2% quartz	±130gr. magnetite, 3gr. pyrite.
51	6F-64	5	35	20	105	2		2	Pink 1ml Purple 1ml	Covered	Graywacke, argillite, slate, sandstone, -2% quartz	±140gr. magnetite.

Map No.	Sample No.	Fig. No.	Concentration (ppm) Cu	Pb	Zn	Mo	Ni	Cx ml dye	Color Reaction	Bedrock	Creek Float	Concentrates
52	6F-65	5	45	20	105	2		1	Purple	Covered	Graywacke, argillite, slate, sandstone, little greenstone	±125gr. magnetite, 5gr. pyrite, 3gr. zircon.
53	6F-66	5	45	20	110	2		4	Pink 2ml Purple 2ml	Covered	Graywacke, argillite, slate, sandstone, ±2% quartz	±200gr. magnetite, 10gr. pyrite, 2gr. zircon
54	6F-67	5	40	20	100	3		6	Pink 1ml Purple 2ml Brown 3ml	Covered	Graywacke, argillite, slate, and greenstone, -5% quartz	-0.1% magnetite, 6gr. pyrite.
55	6F-68	5	40	15	105	3		11	Pink 2ml Red 2ml Purple 7ml	Covered	Graywacke, argillite, slate, and greenstone, -5% quartz	-0.1% magnetite, 7gr. zircon, 8gr. pyrite.
56	6F-69	5	35	15	95	2		2	Pink 1ml Purple 1ml	Covered	Graywacke, shale, slate, argillite, and dike	-0.1% magnetite, 4gr. pyrite, 12gr. zircon.
57	6F-70	5	40	15	90	2		8	Pink 4ml Purple 2ml Brown 2ml	Covered	Graywacke, argillite, slate, shale, greenstone, ±2% quartz	-0.1% magnetite, 4gr. zircon.
58	6F-71	5	25	5	80	3		+20	Pink 6ml Purple 5ml Brown +9ml	Covered	Graywacke, argillite, slate, shale and greenstone, ±5% quartz	-200gr. magnetite, 3gr. pyrite.
59	6F-72	5	40	20	85	3		±20	Pink 4ml Purple 9ml Brown +7ml	Covered	Graywacke, argillite, slate, shale, greenstone, ±5% quartz	-200gr. magnetite, 4gr. pyrite.

Map No.	Sample No.	Fig. No.	Concentration (ppm) Cu	Pb	Zn	Mo	Ni	Cx ml dye	Color Reaction	Bedrock	Creek Float	Concentrates
60	6F-73	5	20	15	75	2		2	Purple 2ml	Covered	Graywacke, argillite, slate, shale, greenstone, ±5% quartz	-0.1% magnetite 5gr. zircon.
61	6F-74	5	30	5	85	2		3	Blue-gray- 3ml	Covered	Graywacke, argillite, slate, shale, greenstone, ±5% quartz	-200gr. magnetite, 3gr. pyrite, 10gr. zircon.
62	6F-75	5	15	10	70	1		5	Purple 3ml	Covered	Graywacke, argillite, slate, shale, greenstone, -2% quartz	28gr. magnetite 2gr. zircon.
63	6F-76	5	20	10	70	1		5	Pink 3ml Purple 1ml	Covered	Graywacke, argillite, slate, shale, greenstone, -2% quartz	-200 gr. magnetite.
64	6F-77	5	15	5	75	2		1	Pink 1ml	Covered	Graywacke, argillite, slate, sandstone, little dike & greenstone, +2% quartz	±100gr. magnetite, 2gr. zircon.
65	6F-78	5	35	10	100	3		5	Pink 3ml Purple 2ml	Covered	Graywacke, argillite, slate, sandstone, little dike and greenstone, +2% quartz	70gr. magnetite 1gr. zircon.
66	6F-79	5	20	10	80	4		2	Purple 2ml	Covered	Graywacke, argillite, slate, sandstone, little dike and greenstone, +2% quartz	±200gr. magnetite, 4gr. zircon.

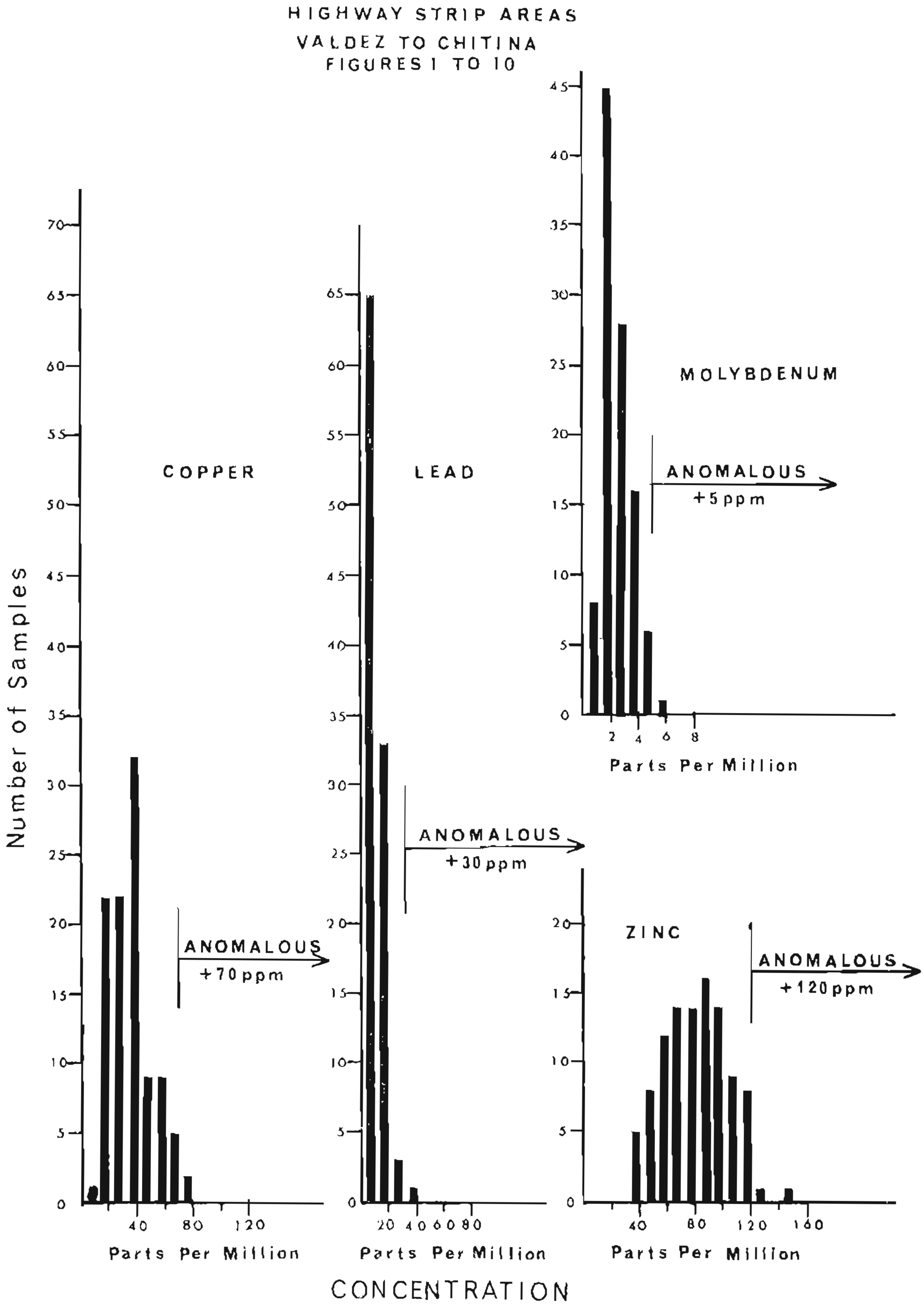
Map No.	Sample No.	Fig. No.	Concentration (ppm) Cu	Pb	Zn	Mo	Ni	Cx ml dye	Color Reaction	Bedrock	Creek Float	Concentrates
67	6F-80	5	25	10	90	4		2	Purple 2ml	Covered	Graywacke, argillite, slate, sandstone, little dike and greenstone, +2% quartz	±200 gr. magnetite, 3gr. pyrite, 3gr. zircon.
68	6F-81	5	25	10	60	3		2	Purple 2ml	Covered	Graywacke, argillite, slate, sandstone, little dike and greenstone, +2% quartz	-0.1% magnetite, 2gr. pyrite, 15gr. zircon.
69	6F-82	5	15	5	45	4		1	Purple	Covered	Graywacke, argillite, slate, sandstone, little dike and greenstone, +2% quartz	±200gr. magnetite, 3gr. zircon.
70	6F-83	6	25	10	75	3		0		Covered	Metasediments with some granite, greenstones and dike	-0.1% magnetite, 3gr. pyrite, 33gr. zircon.
71	6F-84	6	20	10	60	2		0		Covered	Metasediments with some granite, greenstone and dike	-0.1% magnetite, 3gr. pyrite, 2gr. zircon.
72	6F-85	6	15	5	50	2		0		Covered	Metasediments with some granite, greenstones and dike, ±2% quartz	No concentrates.
73	6F-86	6	35	5	90	4		2	Purple	Covered	Metasediments with some granite, greenstone and dike, ±2% quartz	-0.1% magnetite, 2gr. scheelite, 3gr. zircon.
74	6F-87	6	30	5	70	4		2	Purple	Covered	Metasediments with some granite, greenstones and dike, ±2% quartz	-0.1% magnetite, 7gr. zircon.

Map No.	Sample No.	Fig. No.	Concentration (ppm)					Cx ml dye	Color Reaction	Bedrock	Creek Float	Concentrates
			Cu	Pb	Zn	Mo	Ni					
75	6F-88	6	25	5	55	4		+20	Pink 1ml Purple 1ml Brown 6ml Red +12ml	Graywacke & slate	Metasediments with some granite, greenstone and dike, ±2% quartz	±200gr. magnetite, 4gr. pyrite, 8gr. zircon, 3gr. pyrrhotite.
76	6F-89	6	45	10	70	3		5	Purple	Covered	Metasediments with some granite, greenstone and dike, ±2% quartz	-0.1% magnetite, 10gr. zircon, 5gr. pyrrhotite.
77	6F-90	6	25	10	85	4		3	Purple	Covered	Metasediments with some granite, greenstones and dike. ±2% quartz	-0.1% magnetite, 15gr. zircon, 4gr. pyrrhotite.
78	6F-91	6	20	5	65	2		2	Purple	Covered	Metasediments with some granite, greenstones and dike, ±2% quartz	-0.1% magnetite, 6gr. zircon, 5gr. pyrrhotite.
79	6F-141	6	15	-5	45	3	10	+20	Pink 1ml Purple 11ml Blue-gray- +8ml	Covered	Sands only	-0.1% magnetite. 1gr. zircon, 3gr. pyrrhotite.
80	6F-92	7	15	5	45	1		6	Pink 1ml Purple 5ml	Covered	Graywacke, argillite, sandstone. Little granite, greenstone, and dike, ±2% quartz	-0.1% magnetite, 3gr. pyrite, 17gr. zircon, ±10gr. pyrrhotite.
81	6F-93	7	15	5	45	3		2	Purple	Covered	Graywacke, argillite, sandstone. Little granite, greenstone, and dike, ±2% quartz	-0.1% magnetite, 5gr. pyrite, 12gr. zircon, 8gr. pyrrhotite.

Map No.	Sample No.	Fig. No.	Concentration (ppm) Cu	Pb	Zn	Mo	Ni	Cx ml dye	Color Reaction	Bedrock	Creek Float	Concentrates
82	6F-94	7	20	5	65	1		17	Purple 1ml Pink 12ml Purple 4ml	Covered	Graywacke, argil-lite, sandstone. Little granite, greenstone, and dike, ±2% quartz	-0.1% magnetite, 23gr. zircon, 26gr. pyrrhotite.
83	6F-95	7	10	-5	45	2		1	Purple	Covered	Graywacke, argil-lite, granite, greenstone, & dike	-0.1% magnetite, 4gr. pyrite, 6gr. pyrrhotite.
84	6F-96	7	20	5	50	2		1	Purple	Covered	Granite, dike, ar-gillite, and gray-wacke	-20% magnetite, 6gr. pyrite, 30gr. zircon, ±50gr. pyrrhotite.
85	6F-97	7	15	5	40	1		2	Blue-gray	Covered	Granite, dike, gre-enstone & graywacke	-10% magnetite, 8gr. pyrite, 40gr. zircon, ±60gr. pyrrhotite.
86	6F-98	7	15	5	40	2		2	Pink	Covered	Granite, dike, gre-enstone, graywacke	-5% magnetite, 11gr. pyrite, 8gr. zircon, ±70gr. pyrrhotite.
87	6F-99	7	25	5	40	4		1	Blue-gray	Covered	Granite, dike, green-stone, and graywacke	±50% magnetite, 9gr. pyrite, 55 gr. zircon, ±50 gr. pyrrhotite.
88	6F-100	7	25	10	60	3		0		Covered	Ultramafic, granite, greenstone, dikes, argillite, and gray-wacke, ±2% quartz	-25% magnetite, 7gr. pyrite, 45gr. zircon, -50gr. pyrrhotite.
89	6F-101	7	20	5	50	2		1		Covered	Ultramafic, gran-ite, greenstone, dike, argillite, & graywacke, ±2% quartz	-20% magnetite, 10gr. pyrite, 35gr. scheelite, -30gr. pyrrhotite.

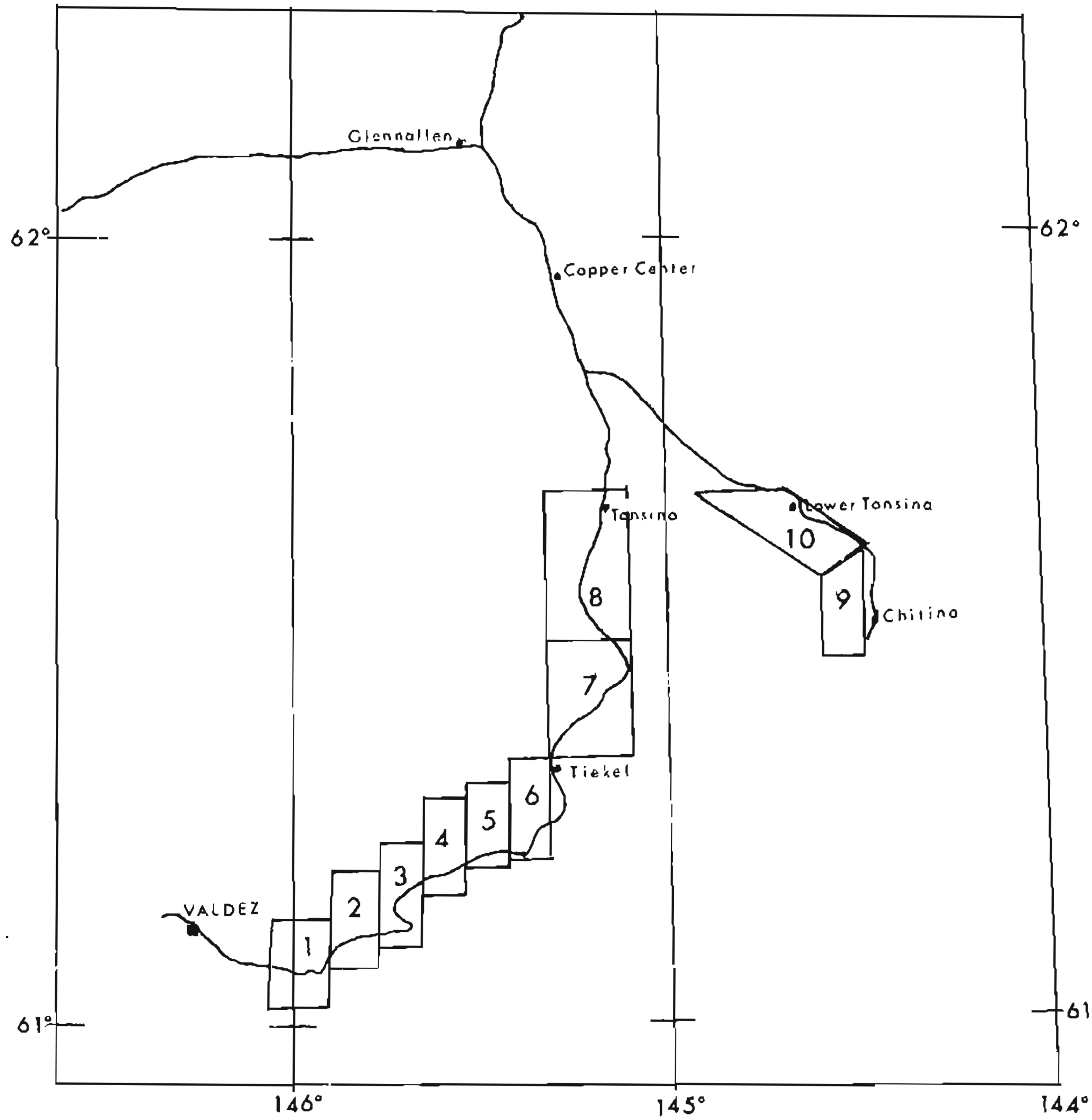
Map No.	Sample No.	Fig. No.	Concentration (ppm) Cu	Pb	Zn	Mo	Ni	Cx ml dye	Color Reaction	Bedrock	Creek Float	Concentrates
90	6F-102	7	15	5	50	2		1	Purple	Covered	Ultramafic, granite, greenstone, dike, argillite & graywacke, ±2% quartz	-20% magnetite, 4gr. pyrite, 48gr. zircon, ±25gr. pyrrhotite.
91	6F-103	7	20	5	40	2		1	Purple	Covered	Granite, greenstone, dike and metasediments	No concentrates.
92	6F-104	7	20	20	45	1		0		Covered	Granite, greenstone, dike, and metasediments	-0.1% magnetite, 14gr. pyrite, 5gr. zircon.
93	6F-142	8	25	5	55	2	20	+20	Pink 3ml Purple +17ml	Covered	Granite, graywacke, argillite, greenstone, and dike, ±2% quartz	-1% magnetite, 11gr. pyrite, ±90gr. zircon, 8gr. pyrrhotite.
94	5F-149	9	80	10	<u>120</u>	3		4	Purple	Argillite	Argillite, slate, shale, granite, dike, greenstone, & little schist	±10% magnetite, 6gr. pyrite, 4gr. zircon, -1% pyrrhotite.
95	6F-143	9	25	5	55	3	10	2	Pink 1ml Purple 1ml	Greenstone	Greenstone, dike, little serpentine, graywacke and argillite	-5% magnetite, 8gr. pyrite, 12gr. pyrrhotite.
96	5F-150	9	60	5	70	3		3	Pink 2ml Purple 1ml	Greenstone	Greenstone, granite, greenstone schist, & graywacke	-5% magnetite, 10gr. pyrite, 3gr. zircon, -0.1% pyrrhotite.
97	5F-151	9	35	5	50	3		4	Pink 2ml Purple 2ml	Covered	Greenstone schist, and granite	-50% magnetite, ±25gr. pyrite, ±100gr. zircon, ±0.1% pyrrhotite.

Map No.	Sample No.	Fig. No.	Concentration (ppm) Cu	Pb	Zn	Mo	Ni	Cx ml dye	Color Reaction	Bedrock	Creek Float	Concentrates
98	5F-152	10	70	10	95	3	80	12	Pink 6ml Purple 6ml	Greenstone & argillite	Greenstone schist, granite, argillite, ±5.0% quartz	No concentrates.
99	5F-153	10	65	5	60	3	45	15	Pink 8ml Purple 7ml	Greenstone & volcanics	Greenstone, volcanics, granite, and porphyries	-5% magnetite, ±20gr. pyrite, ±20gr. pyrrhotite
100	6F-144	10	75	10	70	2	50	5	Red 3ml Purple 1ml Blue-gray-1ml	Greenstone schist	Greenstone schist, granite, graywacke, & little argillite	-2% magnetite, ±10gr. pyrite, 10gr. pyrrhotite. 3gr. zircon.
101	6F-145	10	60	-5	65	3	60	8	Pink 3ml Purple 2ml Blue-gray-3ml	Greenstone schist inferred	Sands only	-1% magnetite, 9gr. pyrite, 3gr. zircon, 5gr. pyrrhotite.
102	6F-146	10	25	-5	50	5	50	7	Pink 3ml Purple 4ml	Greenstone schist inferred	Greenstone schist, granite, and metasediments,-1% quartz	-50% magnetite, 10gr. pyrite, ±100gr. zircon, 20gr. pyrrhotite.



Figures 1 to 10 Frequency—concentration graphs of copper, lead, zinc, molybdenum, and nickel in stream sediment analyses.

DIAGRAM
Showing Locations of
Fig.s 1 to 10



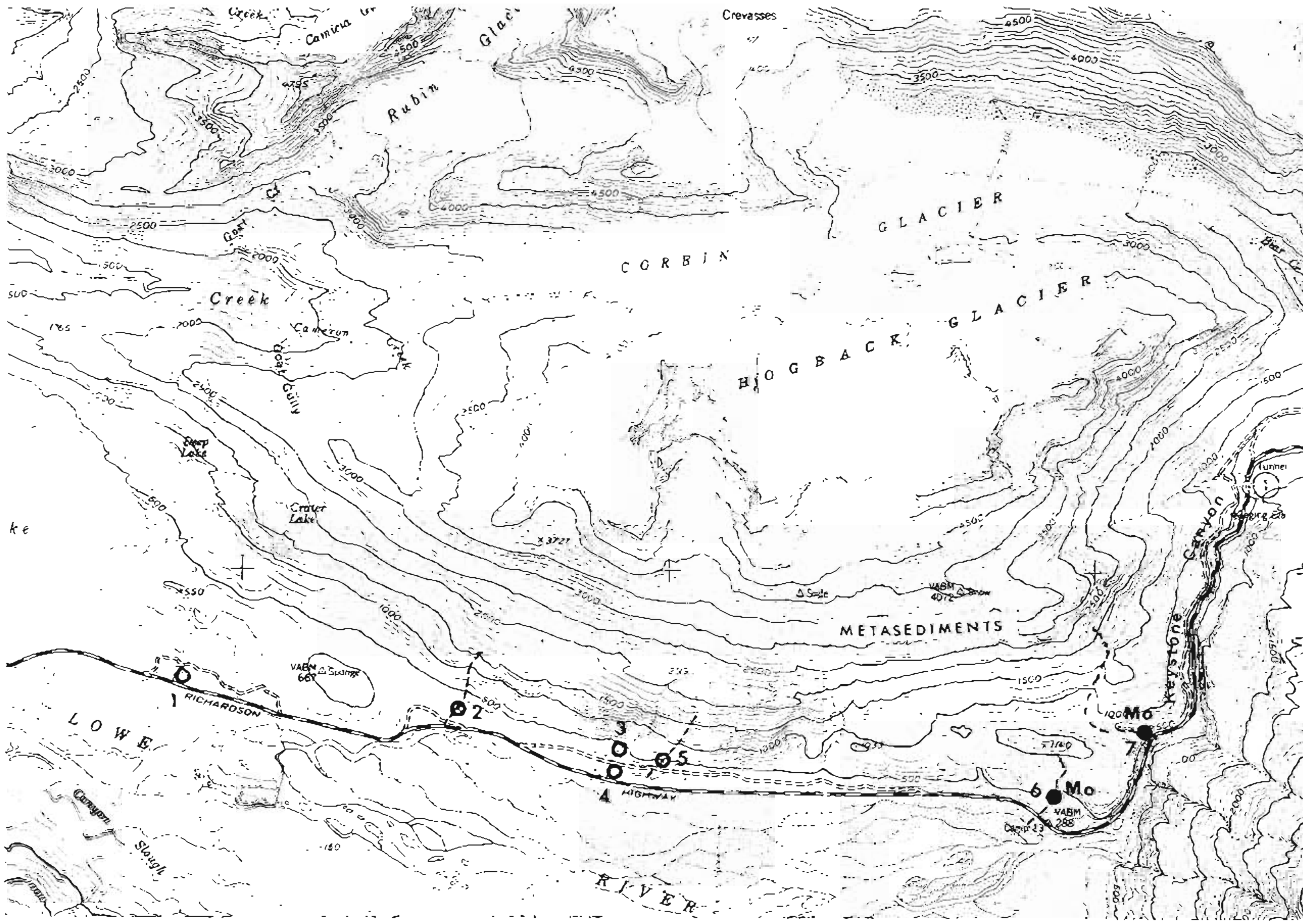

(VALDEZ A-5)
COPPER CENTER 87 MI
BIG TIMBER 11.4 MI
Crevasses
Rubin
CORBIN GLACIER
HOGBACK GLACIER
Creek
Cameron
Goat Gully
Crater Lake
METASEDIMENTS
Keystone Canyon
Tunnel
Mo
Mo
RICHARDSON
HIGHWAY
LOWE
RIVER
Canyon Slough
1
2
3
4
5
6
7

Fig. 1

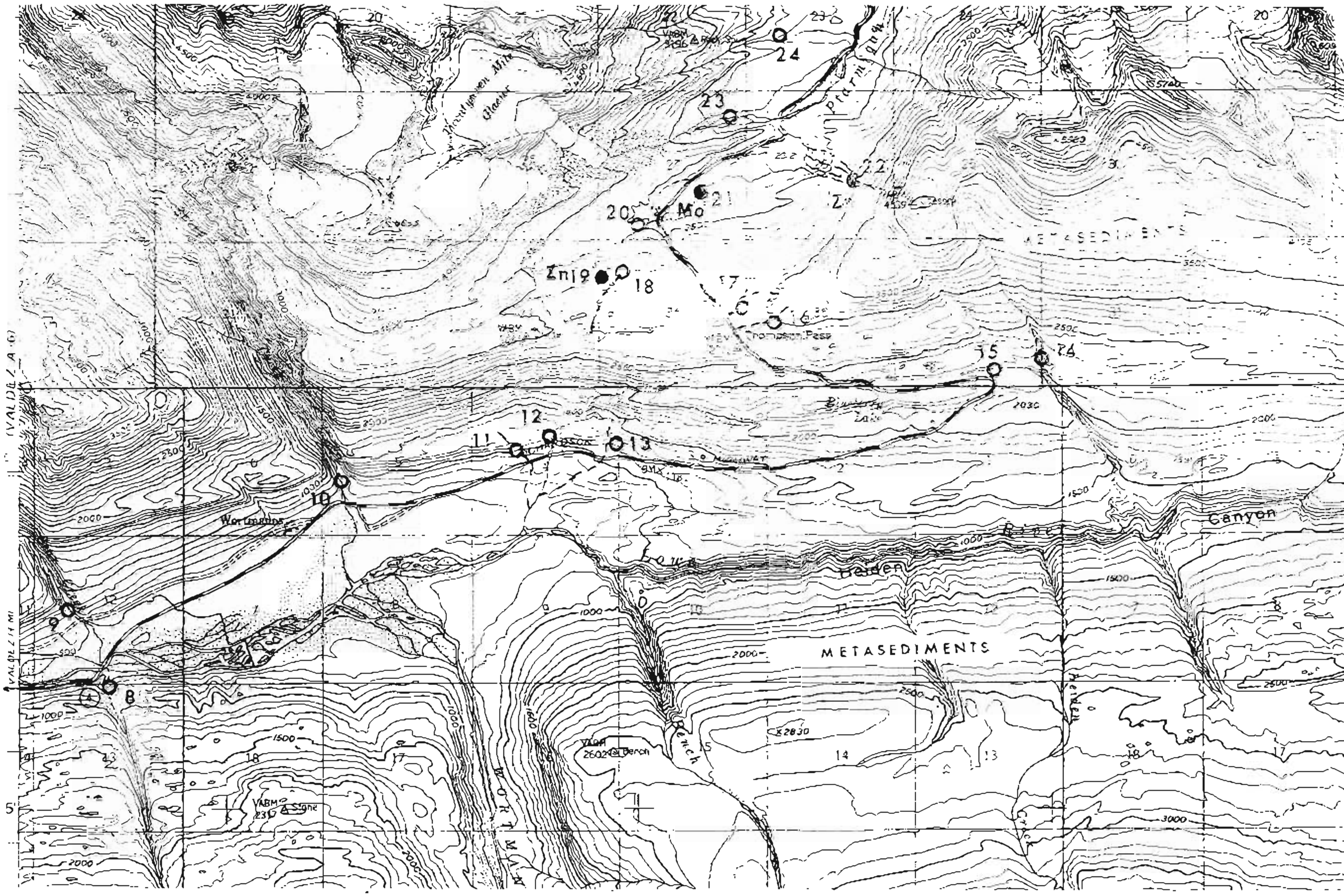
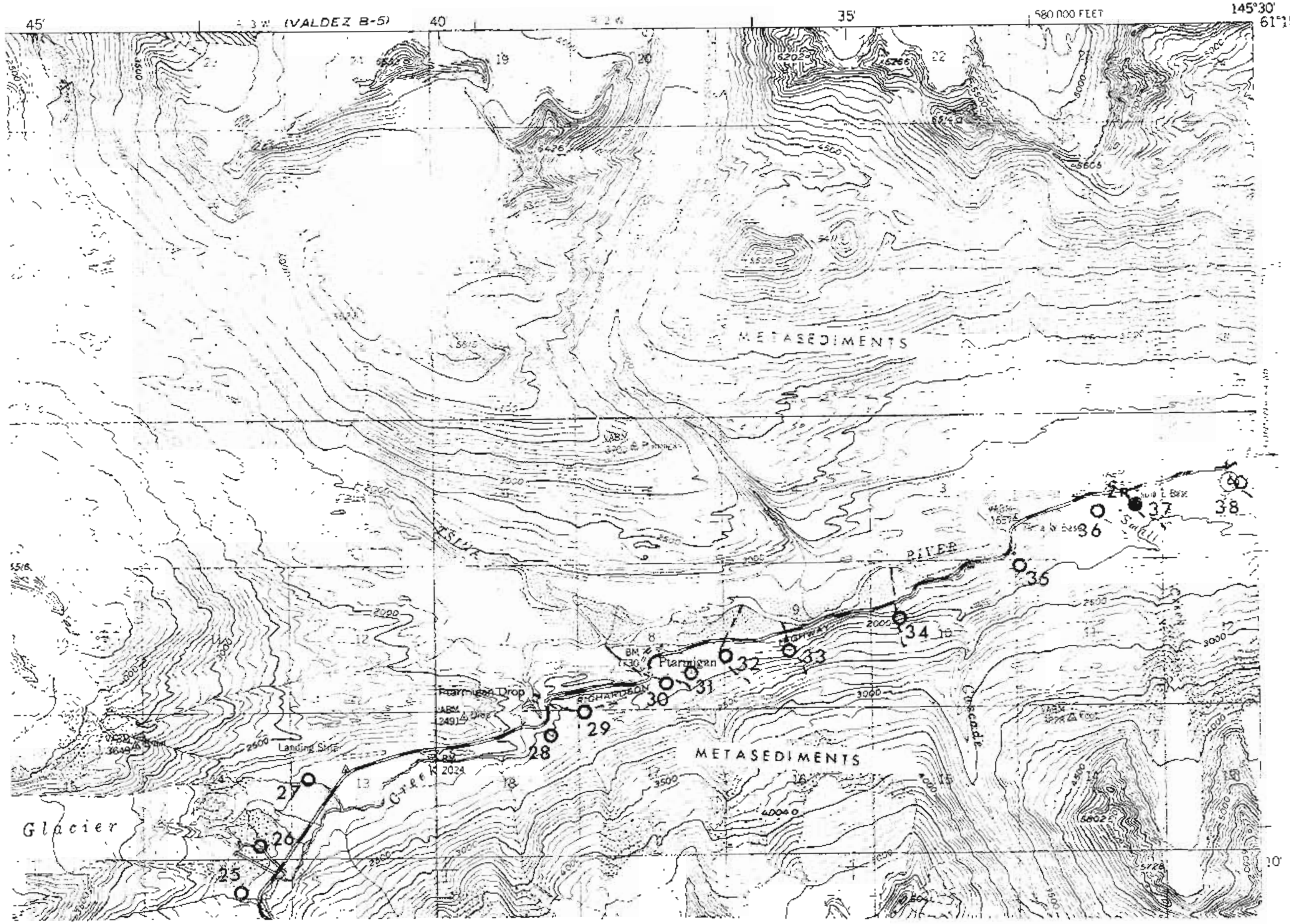

METASEDIMENTS
METASEDIMENTS
Canyon
Heiden
Lowe
Bench
Creek
WORTMAN
Thompson Pass
Mo
Zn
Glacier
24
23
22
21
20
19
18
16
15
14
13
12
11
10
9
8

Fig. 2



45'
(VALDEZ B-5)
40
35'
580 000 FEET
145°30'
61°15
METASEDIMENTS
RIVER
HIGHWAY
RICHARDSON
Ptarmigan Drop
Ptarmigan
Landing Strip
Creek
Glacier
Cascade
METASEDIMENTS
25
26
27
28
29
30
31
32
33
34
35
36
37
38
10'

Fig. 3

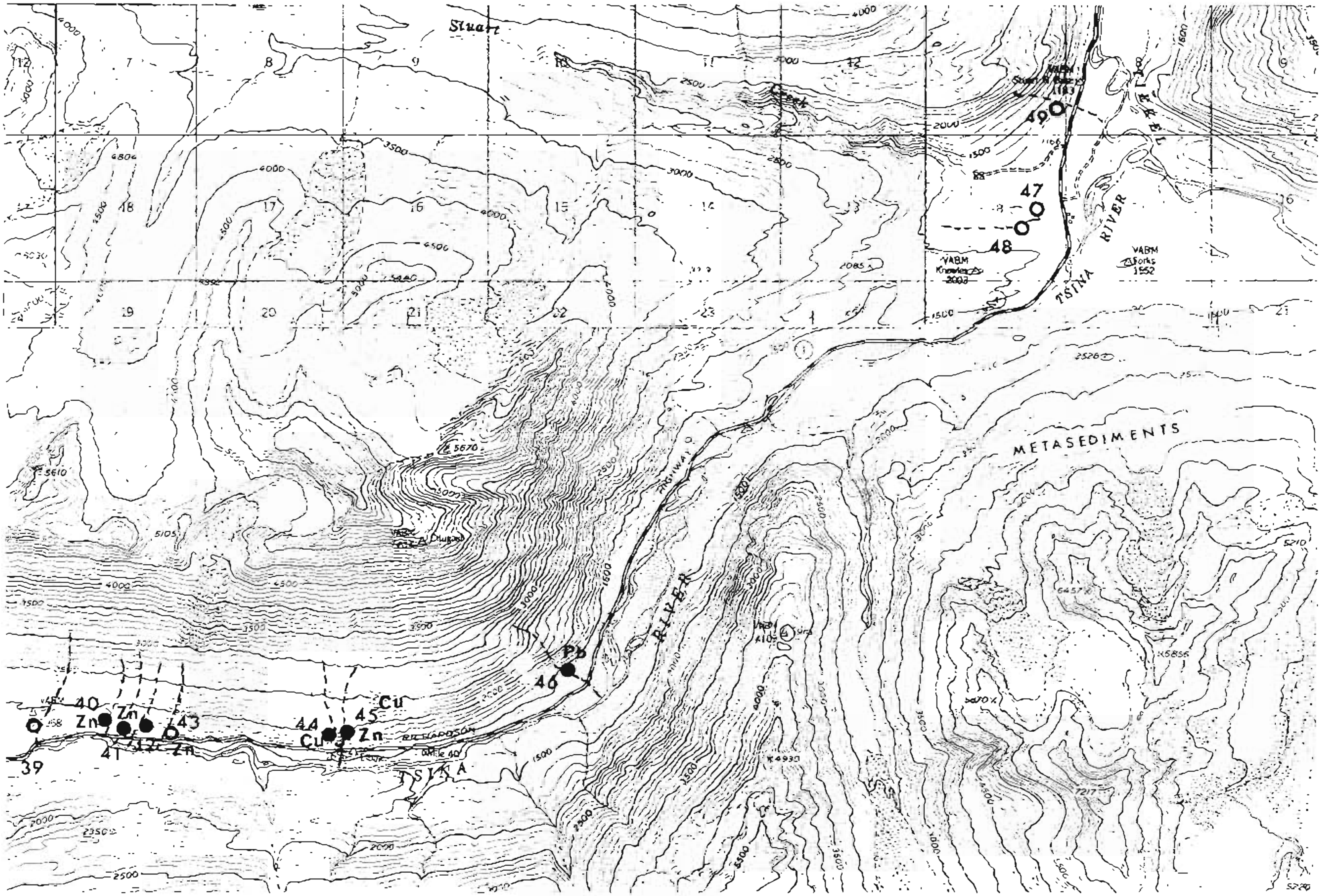
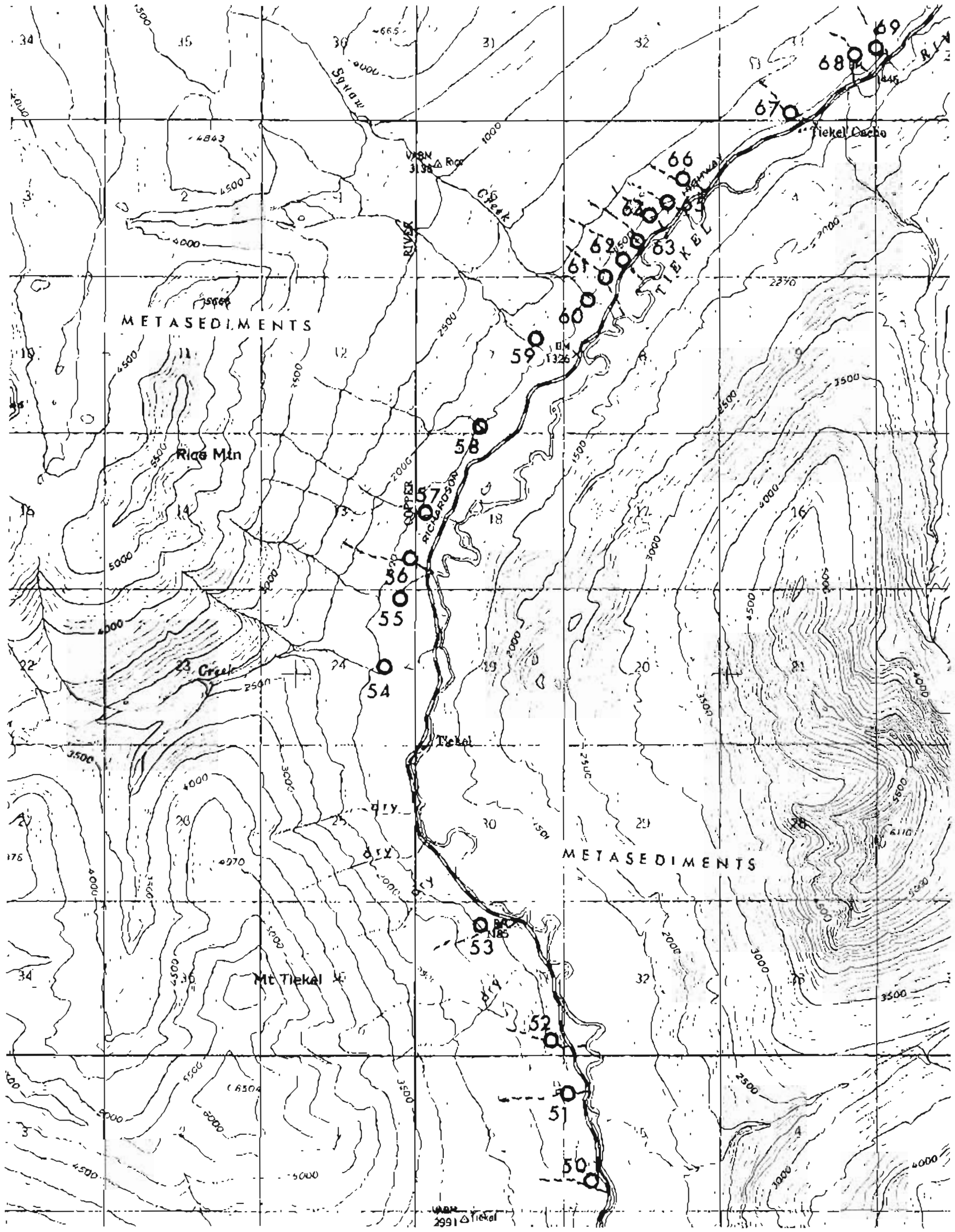

Stuart
METASEDIMENTS
TSINA RIVER
RIVER
TSIKA
Pb
Cu
Zn
39
40
41
43
44
45
46
47
48
49

Fig. 4


METASEDIMENTS
Rice Mtn
Mt Tiekel
Tiekel Cache
Tiekel
TIEKEL
RICHARDSON
COPPER
RIVER
Creek
METASEDIMENTS
50
51
52
53
54
55
56
57
58
59
60
61
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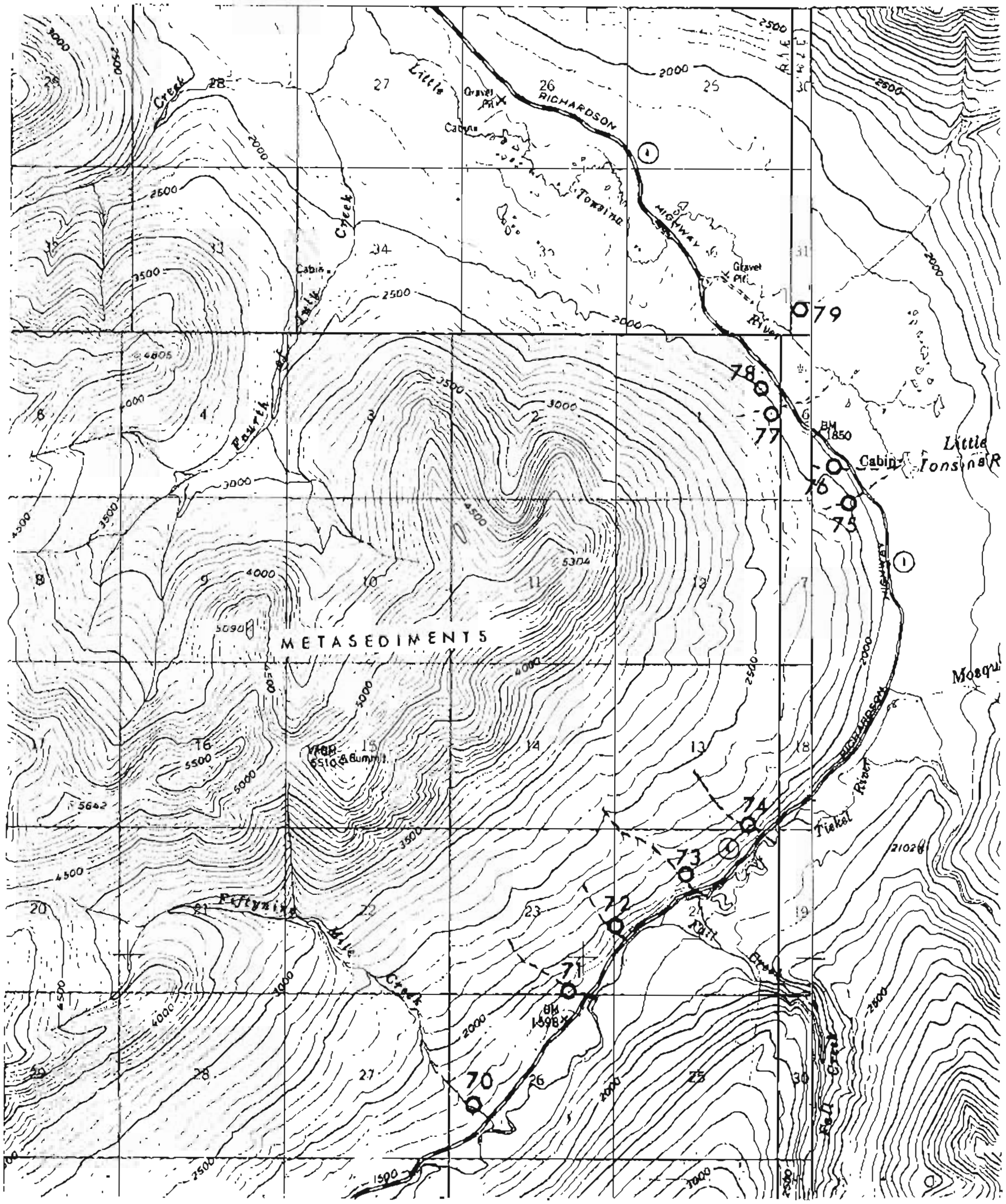
64
65
66
67
68
69

Fig. 5



METASEDIMENTS
RICHARDSON
HIGHWAY
Little Tonsina
River
Little Tonsina R
Fourth of July Creek
Fiftymile Creek
Tiekel River
Mosqu
Cabin
Gravel Pit
79
78
77
76
75
74
73
72
71
70

Fig. 6

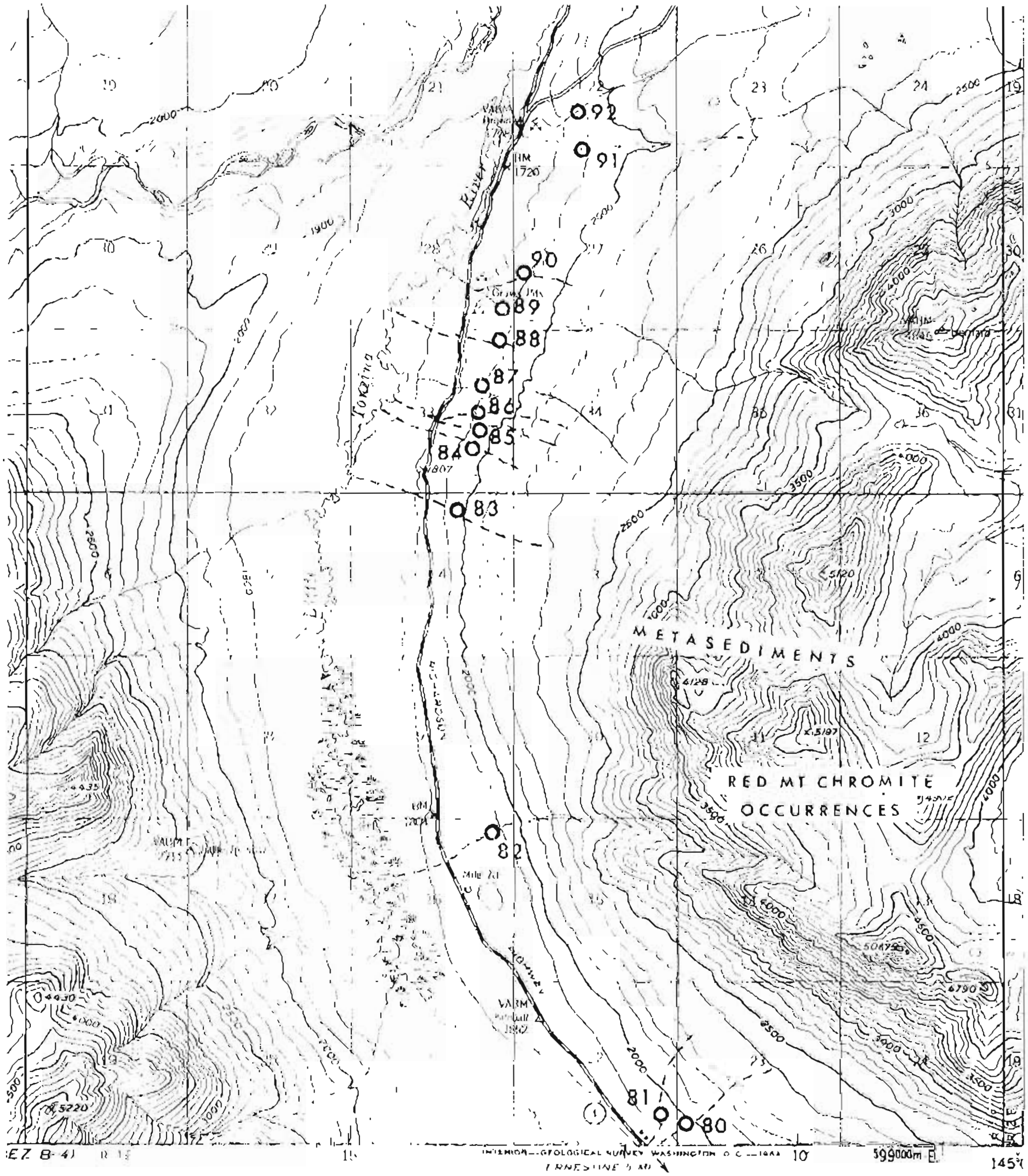

92
91
90
89
88
87
86
85
84
83
82
81
80
METASEDIMENTS
RED MT CHROMITE
OCCURRENCES
River
2000
2500
3000
3500
4000
599000m E.

Fig. 7

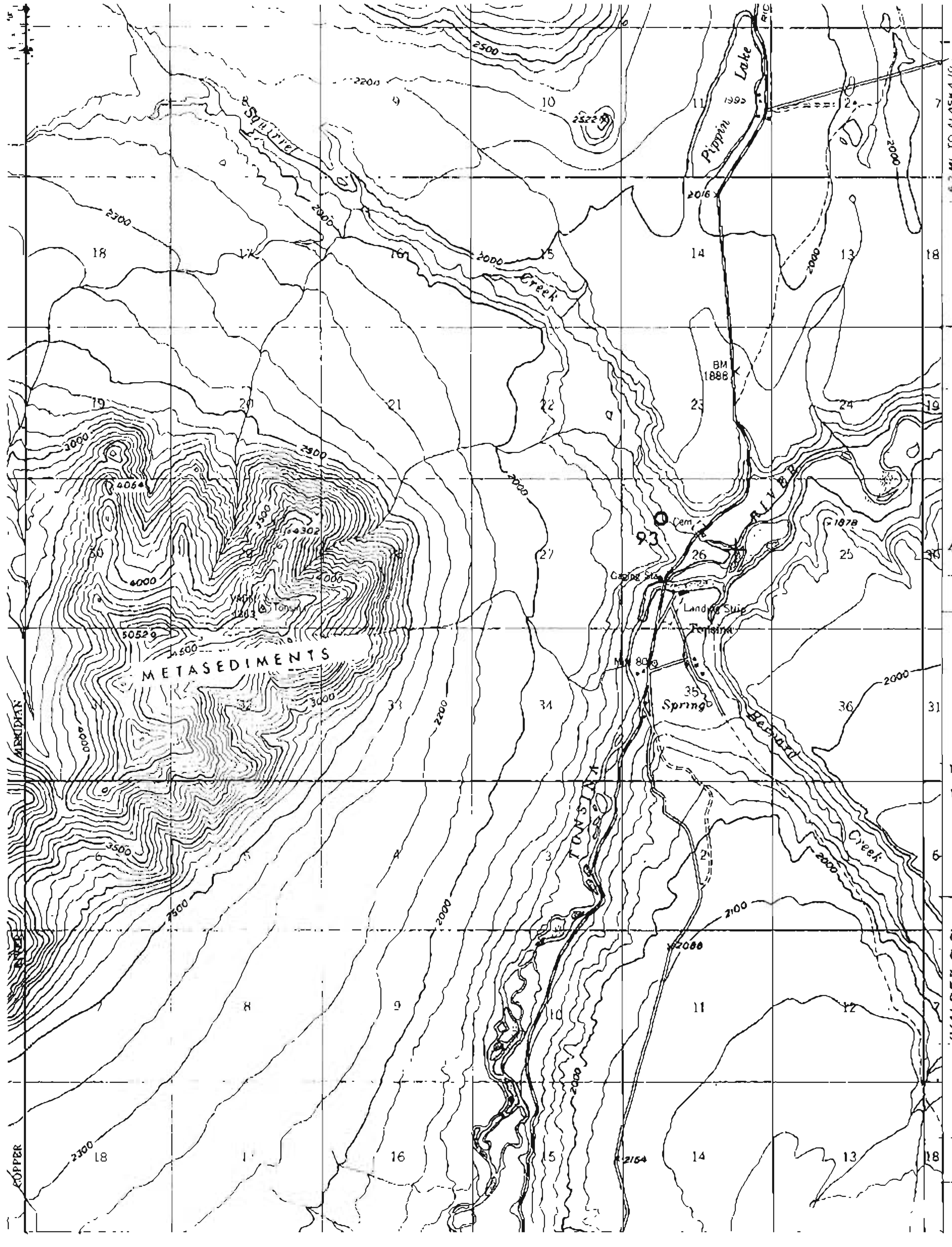

Squirrel Creek
Pippin Lake
METASEDIMENTS
TONSINA
RIVER
Bernard Creek
Spring
Tonsina
Landing Strip
Cem
93
BM 1888
6.2 MI TO ALASKA 10
(VALDEZ C-3)
COPPER
MERIDIAN

Fig. 8

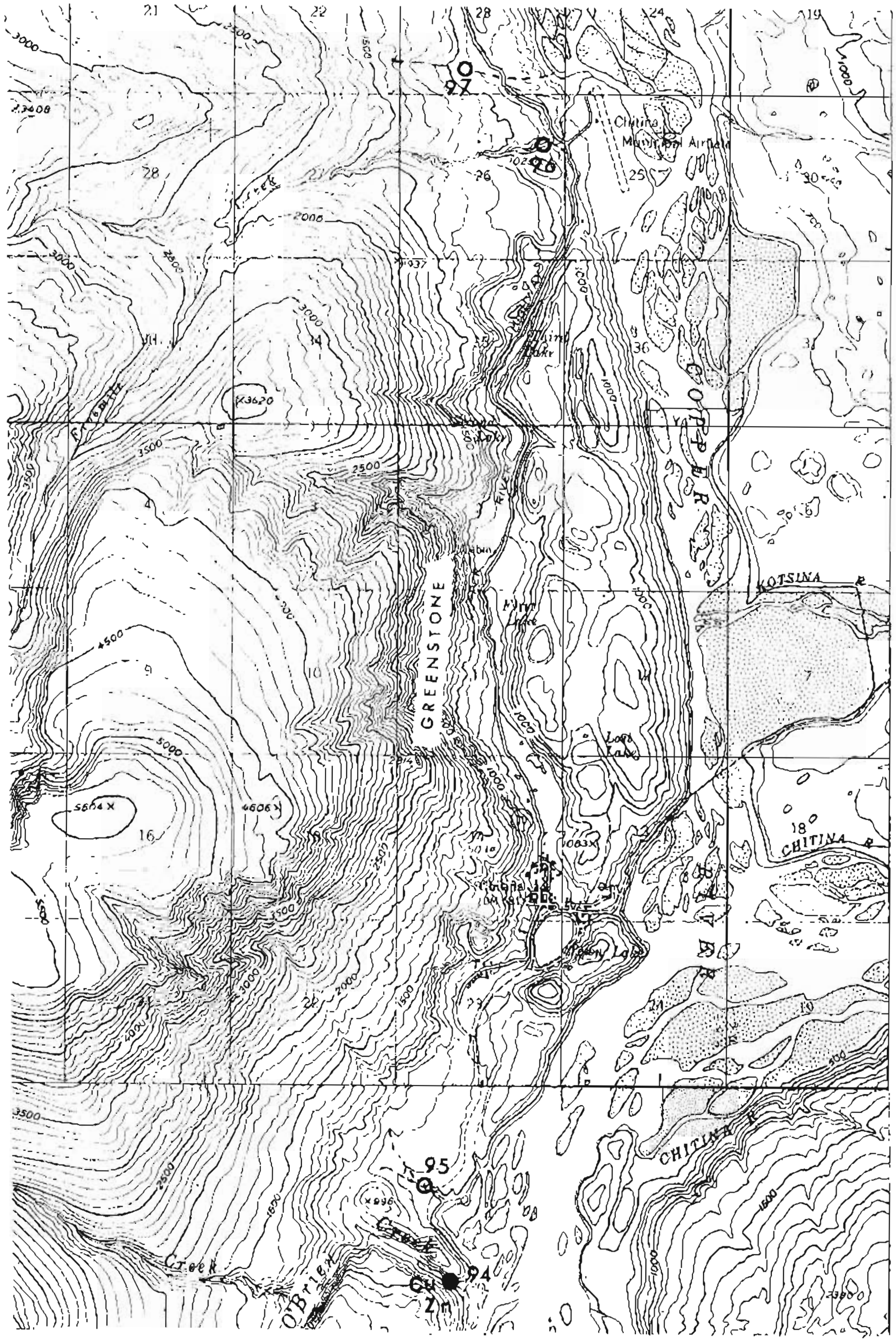
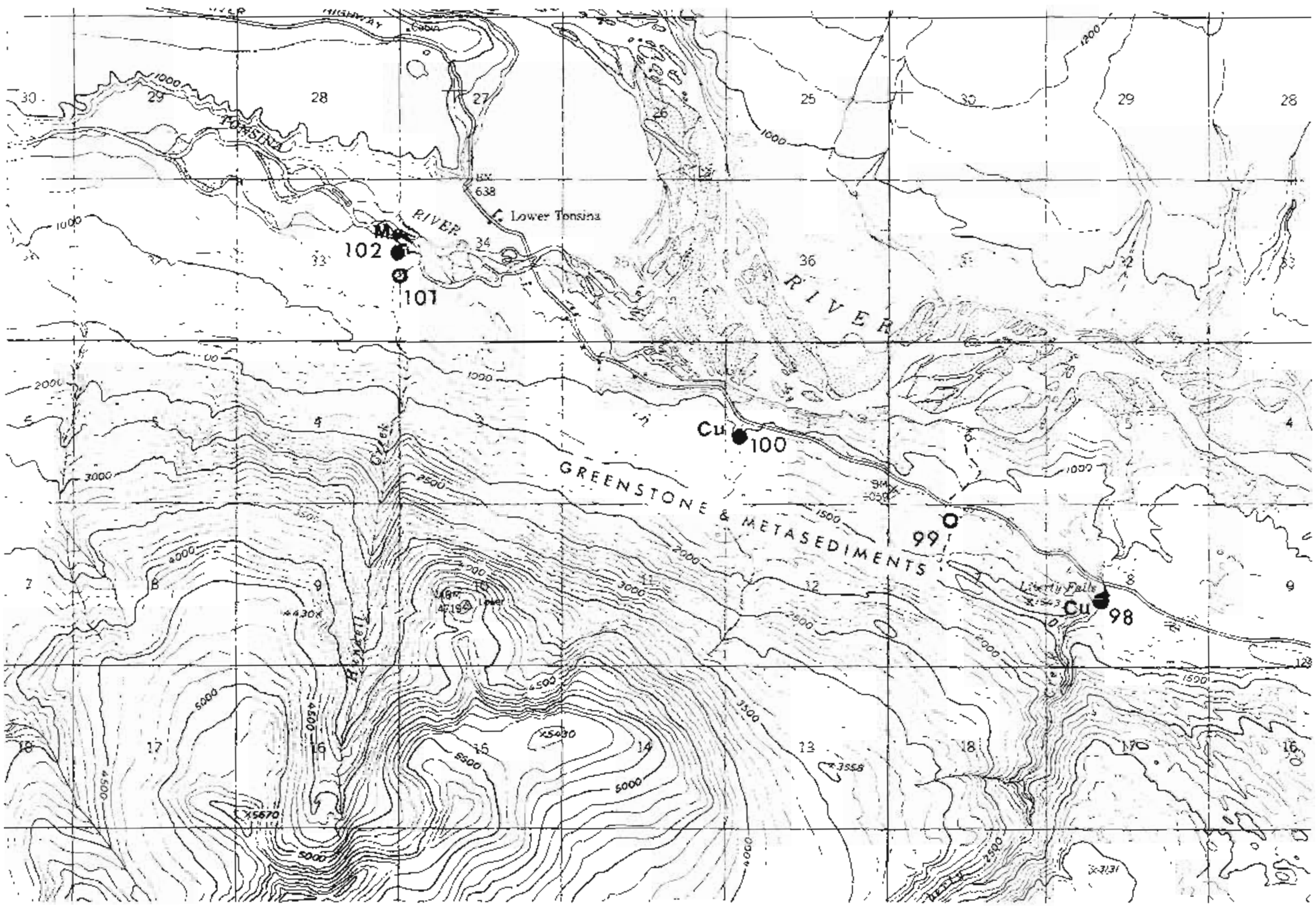

97
96
Chitina Municipal Airfield
GREENSTONE
KOTSINA R
CHITINA R
Lost Lake
95
O'Brien
Creek
94
Cu
Zn

Fig. 9



HIGHWAY
TONSINA
RIVER
Lower Tonsina
Mo
102
101
RIVER
Cu
100
GREENSTONE & METASEDIMENTS
99
Liberty Falls
Cu
98

Fig. 10