TERTIARY/TRIASSIC LITHOGEOCHEMICAL STUDY NORTH KAMLOOPS LAKE AREA (92I/10, 15)

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INTRODUCTION

During 1973 a hole was diamond drilled approximately 2.4 kilometres northwest of Red Point as indicated on Figure 48. The hole is reported to have intersected 1.6 per cent copper from 151 to 157 metres. A program of mapping and lithogeochemistry was carried out with two objectives in mind: (1) to discover potential copper abundances in the overlying Tranquille Formation derived from a possible underlying metallic sulphide deposit in the Nicola Group, and (2) to analyse for gold, silver, mercury, and arsenic to discover anomalies in the Tranquille that might lead to discovery of a precious metal deposit.

Rock samples were analysed at the British Columbia Ministry of Energy, Mines and Petroleum Resources' laboratory and the results are tabulated in Tables 1 and 2 (pages 154 to 157). For geochemical comparison purposes the Triassic to Lower Jurassic rocks have been placed in one group (Table 1) and the Eocene rocks in another. Nicola Group volcanic breccias, flows, and tuffs of andesitic to basaltic composition are recognizable in the field. Although the intensity of both epidote, calcite, hematite, chlorite alteration, and orthoclase feldspar metasomatism varies from outcrop to outcrop, copper values seem to be higher in the more altered rocks. Results for Eocene rocks of the Tranquille Formation are listed in Table 2.

North of Red Point, samples MM 82-76, 77, 78, and 79 are included with Triassic rocks based on the geochemical data; they are believed to be transported Nicola volcaniclastic rocks.

ANALYTICAL METHODS

Atomic absorption was used to analyse for gold (MM series only), silver, arsenic, and mercury. Gold for the GW series has a different gold detection limit than the MM series because GW samples were analysed by the gravimetric method. Gold values for MM samples are expressed in ppb while GW samples are in ppm.

GEOLOGY

INTRODUCTION

The area is underlain by Upper Triassic to Lower Jurassic Nicola volcanic and Iron Mask intrusive rocks, unconformably overlain by Eocene sedimentary and volcanic rocks of the Tranquille Formation.

Topographic changes are moderate, except for deeply incised stream valleys which give rise to cliffs in excess of 100 metres high.

In the following sections, numbers in parenthesis refer to outcrop sites on the plan (Fig. 48).

TRIASSIC

The Nicola Group consists of flows, flow breccias, tuff breccias, lapilli tuffs, and, locally, finely laminated tuffs that are brown-maroon in colour if altered to hematite or green if altered to epidote-chlorite; all are of andesitic to basaltic composition. The crystal tuffs form outcrops northeast of Red Point (20) and generally can be traced in the field. Flows and flow breccias are often porphyritic with ophitic to subophitic texture due to closely spaced euhedral to subhedral, fine to medium-grained plagioclase grains in an epidotized and chloritized, green matrix. A basalt dyke of possible Tertiary age was noted near the railway line northeast of Red Point (86); it intrudes a basalt flow. A lahar-like bed (18) containing polylithic, rounded clasts up to 15 centimetres in diameter is present below a waterfall south of the old Maxine mine workings and just south of the crystal tuff outcrop (20). The number of marker horizons are insufficient to estimate stratigraphic thicknesses of the Nicola Group.

The entire Nicola Group volcanic intrusive sequence has been subjected to pervasive epidote, chlorite, carbonate, and orthoclase feldspar alteration which abruptly varies in intensity from place to place. The most intense alteration was observed near Frederick siding. Although the original character is, for the most part, still apparent, Nicola rocks are on occasion changed to brick red syenite. The stronger alteration is commonly accompanied by copper mineralization.

The contact between Triassic and Tertiary rocks was not found. It is possible that a few large (10 by 20-metre) transported blocks of Triassic are present within Tertiary rocks above Red Point (75 and 77).

TERTIARY

The Tranquille Formation in this area consists of a basal sedimentary unit overlain by a sequence of volcanic rocks of basic to intermediate composition. Basalt and andesite dykes with a general northwesterly strike crosscut both the volcanic and sedimentary units.

The basal sedimentary unit is at least 40 metres thick and consists of sandstone, siltstone, mudstone, chert, and minor amounts of conglomerate. Grey to greyish white tephra layers are present in this unit north of Red Point; fish fossils were found at sites (69 and 76) in a fissile arkosic sandstone; plant fossils and coaly fragments are common in this thinly bedded, basal section. Olivine basalt and augite porphyries in 15-metre-thick layers that contain 4-metre-long pillows with discontinuous, interpillow sandstone wedge occur with the sedimentary beds west of the study area.

Volcanic rocks overlying the basal sedimentary unit consist of augite porphyry, olivine basalt, augite porphyry, breccia, pillowed basalt, pillow basalt breccia, andesite breccia, and basalt and andesite flows, as well as trachyte porphyry, flows, ash flows and dykes, and rhyolite ignimbrite. Bentonite beds 7 metres in thickness and derived from basaltic glass are interlayered with the basalt flows.

Basalt and andesite dykes that cut the sedimentary and volcanic rocks measure up to 10 metres in width, strike 120 degrees, and are nearly vertical.

A new location (51) of the zeolite ferrierite is shown on Figure 48. The identity of this rare mineral was recognized in the field and later confirmed in the laboratory. Another better known ferrierite locality in this region is at mile 17.5 of the Canadian National Railway, west of the map-area.

DISCUSSION OF LITHOGEOCHEMICAL RESULTS

A series of histograms accompany this report (Figs. 49 to 54, pages 158 to 160). The mean value of copper for Triassic rocks is 70 ppm and is somewhat higher than the mean of 50 ppm for Tertiary rocks. The broad scattering of values in this distribution is a reflection of the degree of alteration and attendant copper mineralization of the Nicola/Iron Mask rocks. Tranquille rocks, in contrast, show a much more concentrated distribution of values reflecting a substantially lower degree of alteration.

Mean values for gold and mercury Nicola/Iron Mask rocks (35 and 37 ppb) and Tranquille rocks (27 and 31 ppb) are only marginally different suggesting that the distributions of these two metals have been less affected by alteration in the Nicola/Iron Mask suite.

ACKNOWLEDGMENTS

All analyses were carried out by the British Columbia Ministry of Energy, Mines and Petroleum Resources' laboratory in Victoria.

TABLE 1

UPPER TRIASSIC TO LOWER JURASSIC NICOLA GROUP AND IRON MASK, LITHOGEOCHEMICAL RESULTS

Sample No.	Rock Type	Au ppb	Ag ppm	Cu ppm	Hg ppb	As ppm
MM 82- 1	Andesite pyroclastic	39	0.3	45	33	
2	Syenite	65	0.3	124	140	
3	Andesite breccia	57	<0.3	39	35	
4	Silica/calcite vein	31	0.4	92	38	
5	Quartz monzonite	31	<0.3	34	<15	
6	Andesite pyroclastic	32	0.3	440	<15	
7	Andesite breccia	49	0.3	49	20	
8	Andesite breccia	57	0.3	51	31	
9	Andesite crystal tuff	33	0.3	62	48	
10	Andesite pyroclastic	51	0.3	132	<15	
11	Andesite breccia	28	<0.3	24	19	
12	Andesite flow	50	0.4	164	32	
13	Sheared altered rock	36	<0.3	72	97	
14	Altered volcanic breccia	20	0.3	25	21	
15	Andesite flow	20	<0.3	21	18	
16	Mineralized shear	247	0.7	3 700	282	
17	Andesite flow	25	<0.3	54	41	
18	Lahar (?)	36	0.3	35	19	
19	Basalt tuff	28	<0.3	37	37	
20	Fault gouge	52	0.5	480	43	
21	Basalt breccia	33	0.3	54	16	
22	Altered mineralized rock	sample missing				
23	Altered basalt breccia	166	0.4	59	161	
24	Altered basalt tuff	27	<0.3	280	27	
25	Basalt crystal tuff	<20	0.3	120	29	
26	Mineralized basalt breccia	24	117	6 600	1 300	
27	Andesite breccia	24	0.3	290	19	
28	Andesite breccia	33	<0.3	105	22	
55	Syenite	<20	<0.3	215	330	
56	Syenite	<20	0.3	51	82	
57	Syenite	<20	0.3	530	700	
58	Syenite	23	0.4	104	380	
59	Altered crystal tuff	<20	<0.3	215	185	
60	Altered crystal tuff	20	0.3	58	154	
61	Syenite	20	0.3	26	32	
62	Pyroclastic andesite	20	0.3	30	33	
63	Altered andesite breccia	20	0.3	41	53	
64	Basalt	40	0.3	37	66	
65	Syenite	30	0.3	280	32	
66	Altered basalt breccia	<20	0.3	230	91	
80	Syenite	22	0.3	42	18	
81	Augite porphyry dyke	20	0.3	57	-	
82	Fault zone	22	0.3	300	22	
83	Altered volcanic	26	<0.3	40	30	
84	Basalt flow	35	0.3	86	12	
85	Andesite tuff	<20	<0.3	70	10	
85A	Basalt at dyke contact	37	0.3	19	58	

TABLE 1 (continued)

Sample No.	Rock Type	Au ppb	Ag ppm	Cu ppm	Hg ppb	As ppm
MM 82-86	Basalt dyke	<20	0.3	52	35	
86B	Basalt flow	20	<0.3	86	14	
86C	Basalt flow clast	20	0.4	23	43	
87	Basalt tuff	<20	1.2	6 700	42	
87A	Basalt flow	20	<0.3	95	38	
88	Basalt tuff	20	0.3	44	74	
		Au ppm				
GW 131-82	K-feldspar porphyry	<0.3	<10	26	23	19
144	K-feldspar porphyry	<0.3	<10	43	<15	42
154	Porphyritic altered andesite	<0.3	<10	24	<15	8
155	Andesite breccia	<0.3	<10	37	<15	18
156	Basalt flow	<0.3	<10	41	16	7
157	Altererd basalt breccia K-feldspar	<0.3	<10	91	<15	5
158	Basalt breccia	<0.3	<10	58	20	4
159	Andesite flow	<0.3	<10	54	18	4
160	Andesite	<0.3	<10	49	<15	8
161	Altered flow breccia	<0.3	<10	52	15	8
162	K-feldspar-altered pyroclast	<0.3	<10	286	485	3
163	Basalt breccia	<0.3	<10	66	18	3
164	Trachytic flow	<0.3	<10	42	19	4
165	Basalt breccia	<0.3	<10	62	<15	3
166	K-feldspar-altered basalt	<0.3	<10	225	15	6

TABLE 2
EOCENE TRANQUILLE FORMATION, LITHOGEOCHEMICAL RESULTS

Sample No.	Rock Type	Au ppb	Ag ppm	Cu ppm	Hg ppb	As ppm
MM 82-29	Andesite breccia (Nicola ?)	25	10	48	16	
30	Trachyte flow	31	0.3	66	29	
31	Siltstone	32	<0.3	59	32	
32	Rhyolite tuff	<20	<0.3	53	33	
33	Tephra - light coloured	20	<0.3	41	20	
34	Trachyte dyke	20	<0.3	69	15	
35	Ash flow (?) - trachytic	20	<0.3	67	24	
36	Ignimbrite	25	<0.3	95	<15	
37	Trachyte flow	<20	0.3	38	<15	
38	Siltstone	<20	<0.3	58	57	
39	Pyroclastic andesite	<20	<0.3	45	<15	
40	Andesite breccia	<20	<0.3	45	<15	
41	Augite porphyry basalt	<20	<0.3	80	<15	
42	Trachyte porphyry	<20	<0.3	57	<15	

TABLE 2 (continued)

Sample No.	Rock Type	Au ppb	Ag ppm	Cu ppm	Hg ppb	As ppm
MM 82-43	Porphrytic basalt	<20	0.4	49	15	
44	Pyroclastic andesite	25	<0.3	28	<15	
45	Siltstone	<20	0.3	55	<15	
46	Pyroclastic andesite	<20	<0.3	38	58	
47	Andesite flow	<20	0.3	32	20	
48	Pillow basalt augite - porphyry	<20	0.3	37	15	
49	Interstitial siltstone to pillows	<20	0.7	25	66	
50	Siltstone	<20	<0.3	34	51	
52	Augite porphyritic breccia - basalt	30	<0.3	48	<15	
53	Pyroclastic andesite	<20	0.3	55	15	
54	Augite porphyry - basalt	<20	<0.3	66	20	
67	Andesite flow	21	<0.3	41	39	
68	Augite porphyry	<20	<0.3	47	16	
69	Shale	<20	<0.3	55	30	
69A	Tephra	29	<0.3	20	19	
70	Cherty siltstone	<20	<0.3	68	12	
70A	Trachyte (?) ash	<20	<0.3	68	15	
71	Siltstone	<20	0.3	68	17	
72	Andesite flow	<20	0.3	46	20	
73	Siltstone	<20	0.6	50	50	
74	Andesite breccia	44	0.5	51	65	
75	Basal Tertiary conglomerate	<20	0.4	34	16	
76	Nicola fragment (?) in Tertiary	<20	0.4	158	23	
77	Argillaceous siltstone	<20	<0.3	69	116	
77A	White tuff	<20	<0.3	28	70	
78	Altered Nicola (?)	<20	<0.3	205	37	
79	Altered Nicola (?) volcaniclastic	<20	<0.3	154	31	
		Au ppm				
GW 101-82	Altered grey volcanic breccia	<0.3	<10	59	85	1
102	Chert	<0.3	<10	89	64	5
103	Sandstone	<0.3	<10	70	134	2
104	Mudstone	<0.3	<10	54	13	2
105	Trachyte (?)	<0.3	<10	29	50	1
106	Basalt breccia	<0.3	<10	63	19	1
107	Sandstone	<0.3	<10	63	60	30
108	Dacite	<0.3	<10	73	49	2
109	Basalt flow	<0.3	<10	32	40	1
110	Sandstone	<0.3	<10	25	39	3
111	Basalt dyke	<0.3	<10	29	35	2
112	Basalt dyke	<0.3	<10	29	45	3
113	Basalt dyke	<0.3	<10	33	21	1
114	Augite porphyry	<0.3	<10	61	18	1
115	0.6 m quartz-ankerite (?) vein	<0.3	<10	1.69%	276	4

TABLE 2 (continued)

Sample No.	Rock Type	Au ppm	Ag ppm	Cu ppm	Hg ppb	As ppm
GW 116-82	Basalt dyke	<0.3	<10	70	40	2
117	Basalt dyke	<0.3	<10	56	17	1
118	Andesite breccia	<0.3	<10	52	25	9
119	Dacite breccia	<0.3	<10	55	25	3
120	Sandstone	<0.3	<10	36	18	2
121	Basalt breccia	<0.3	<10	52	28	2
122	Basalt breccia	<0.3	<10	62	28	2
123	Basalt breccia with ash flow	<0.3	<10	56	24	2
124	Porphyritic basalt	<0.3	<10	55	23	<1
125	Basalt breccia	<0.3	<10	51	25	2
126	Olivine basalt	<0.3	<10	61	23	3
127	Calcite vein	<0.3	<10	24	25	2
128	Sheared basalt	<0.3	<10	48	20	1
129	Arkosic sandstone	<0.3	<10	40	34	4
130	Porphyritic basalt	<0.3	<10	57	29	1
132	Augite porphyry	<0.3	<10	53	18	2
133	Olivine basalt	<0.3	<10	41	23	2
134	Basalt flow	<0.3	<10	56	18	2
135	Near-pillow basalt	<0.3	<10	51	22	1
136	Pillow basalt	<0.3	<10	48	24	2
137	Groundmass basalt	<0.3	<10	48	36	3
138	Basalt flow (?)	<0.3	<10	43	27	2
139	Trachyte (?) tuff	<0.3	10	32	27	3
140	Porphyritic basalt	<0.3	10	29	27	3
141	Basalt flow	<0.3	10	49	20	2
142	Basalt pillow bx	<0.3	10	58	24	1
143	Basalt pillox bx	<0.3	10	51	21	2
145	Porphyritic basalt	<0.3	10	58	<15	2
146	Sandstone	<0.3	10	44	15	2
147	Basalt sill	<0.3	10	38	54	2
148	Cherty sediment	<0.3	10	67	15	1
149	Columnar basalt	<0.3	10	28	16	3
150	Basalt	<0.3	10	32	21	1
151	Sandstone	<0.3	10	23	<15	2
152	Basalt dyke	<0.3	10	75	15	4
153	Phyllite	<0.3	10	32	15	4
167	Basalt breccia fragment	<0.3	10	65	22	2
168	Basalt breccia fragment	<0.3	10	61	<15	2
169	Augite porphyry	<0.3	10	51	15	2
170	Augite porphyry	<0.3	10	57	15	2
171	Basalt flow	<0.3	10	63	15	2

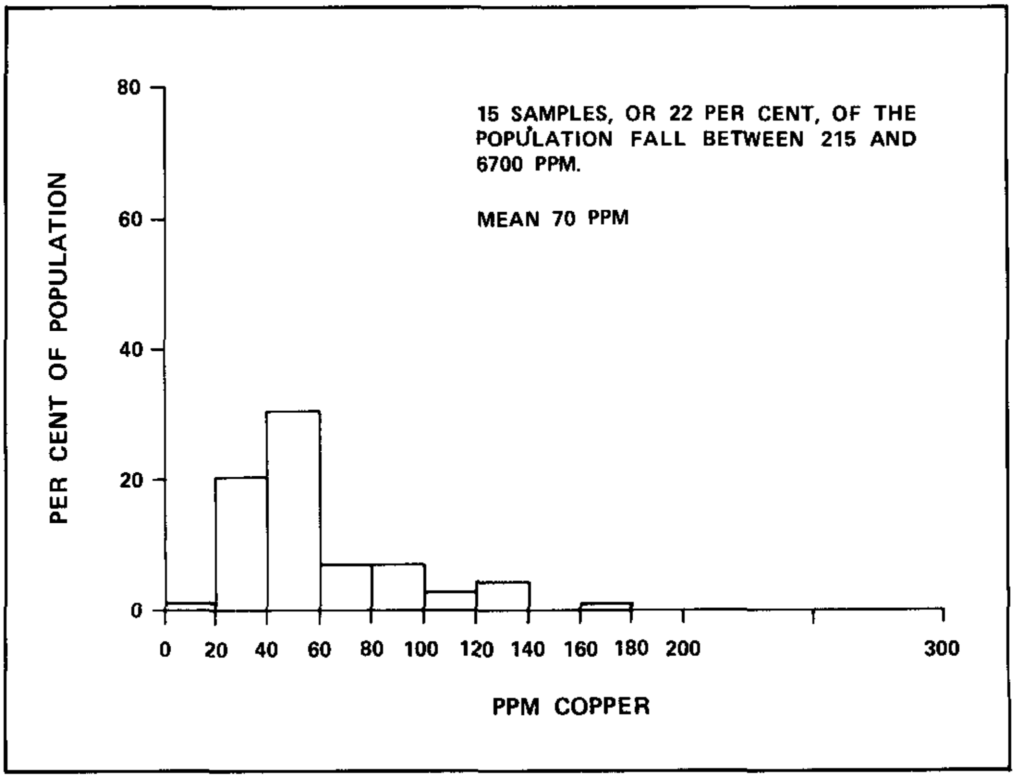

Figure 49. Histogram of copper in 68 Triassic Nicola/Iron Mask samples.

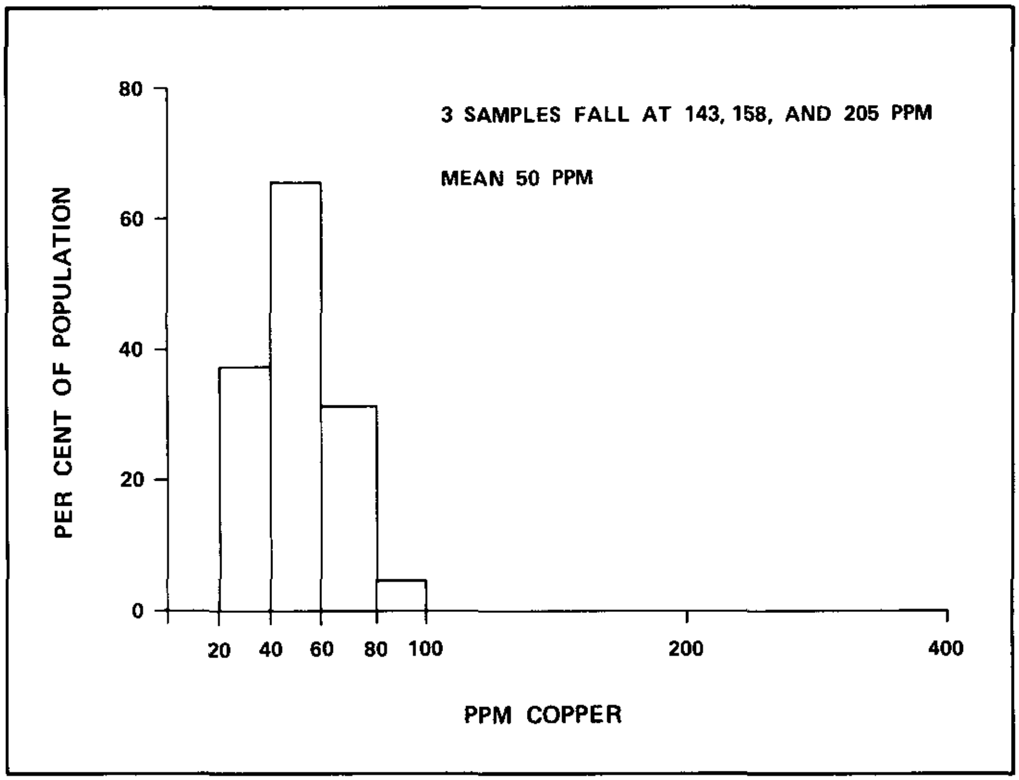

Figure 50. Histogram of copper in 67 Tertiary Tranquille Formation samples.

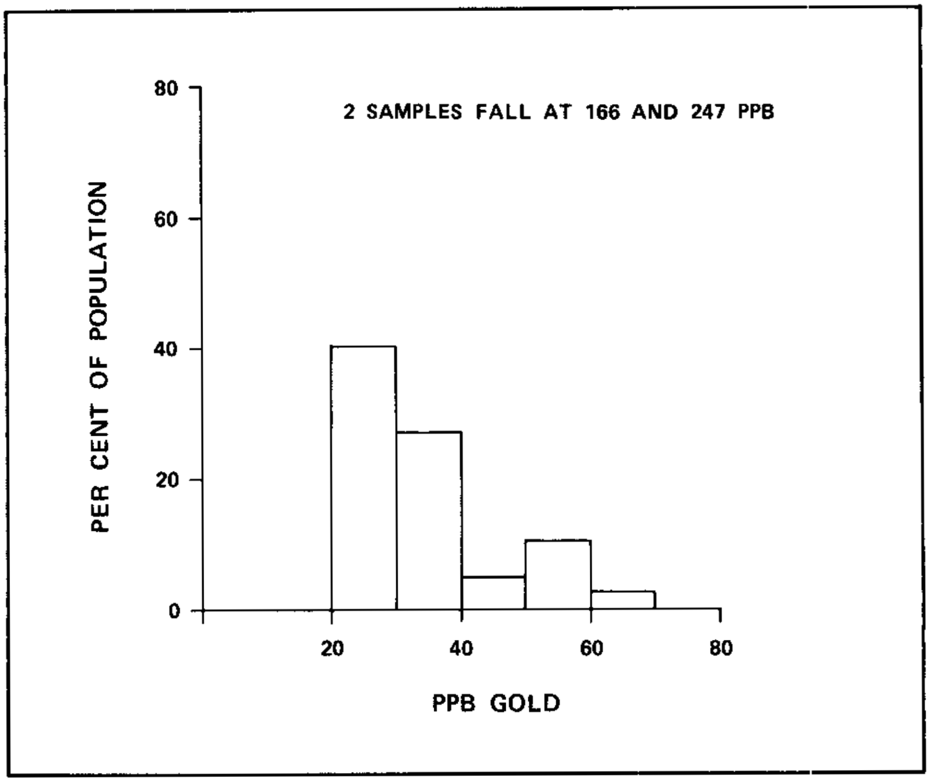

Figure 51. Histogram of gold in Triassic Nicola/Iron Mask samples. Only the 43 samples that exceeded the 20 ppb detection limit are plotted.

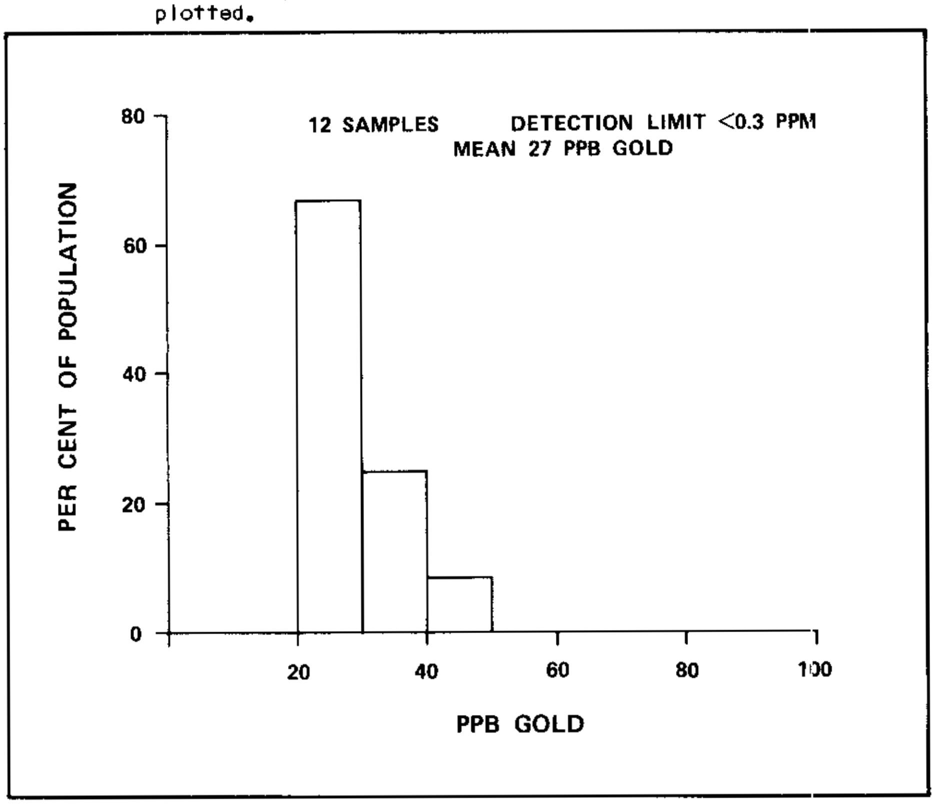

Figure 52. Histogram of gold in Tertiary Tranquille Formation samples. Only the 12 samples that have gold values above the 20 ppb detection limit are plotted.

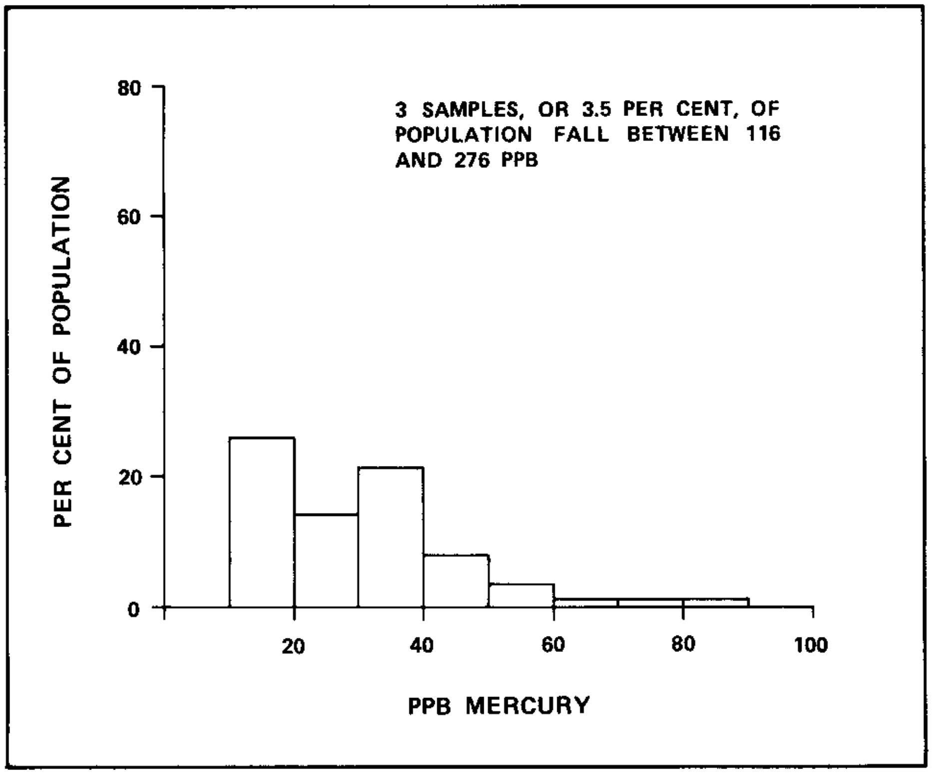

Figure 53. Histogram of mercury in Triassic Nicola/Iron Mask samples. The 57 samples in which Hg exceeded the 15 ppb detection limit are plotted.

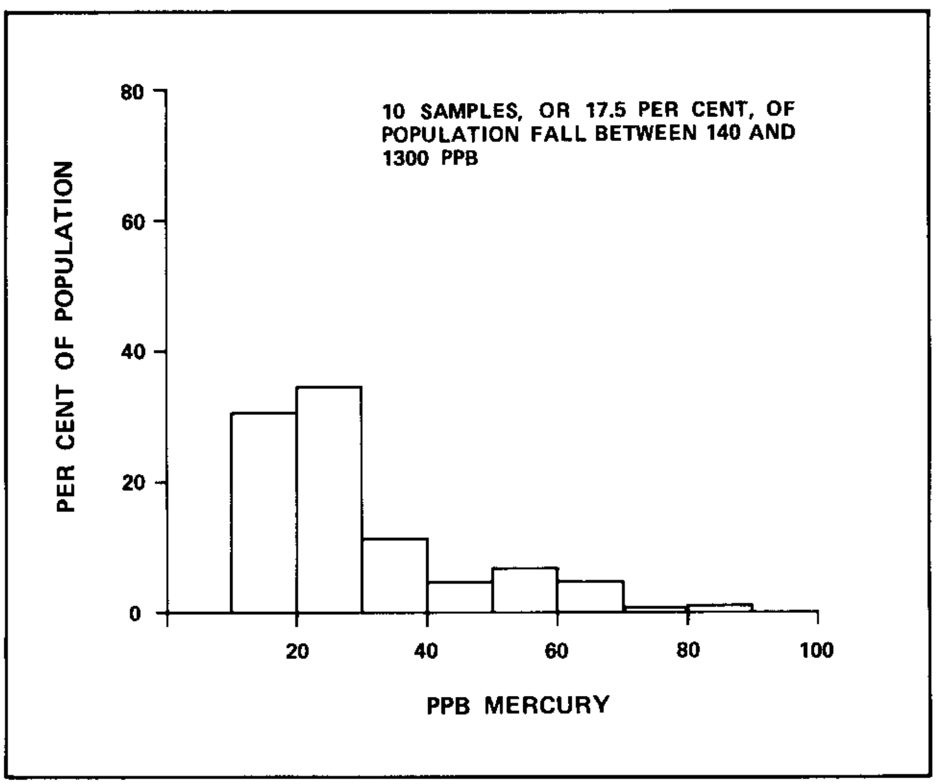

Figure 54. Histogram of mercury in Tertiary Tranquille Formation samples. The 85 samples in which Hg exceeded the 15 ppb detection limit are plotted.