800410 Manson Creek

ZELON CHEMICALS LTD.
201-367 Water Street
Vancouver B.C.

LABORATORY REPORT

Black Pine: K11-8-7 — Reference 3 BP V2-3/75

Client: Kerr Addison Mines — April 3rd 1975

JUNIPERUS-SCOPULORUM SARG

Sample No. BP Series	% Ash	Au ppb	Ag ppm	Mo	Cu	Cu/Zn	Zn	Ni	Bi
					------ppm------				
BP 321	12.5	560	16.8	224	384	1.33	88	56	-20
322	2.1	1900	100	-40	860	1.06	810	330	330
323	11.4	350	18	88	176	0.71	246	61	176
324	2.5	1000	84	-40	200	0.36	560	280	-20
325	9.2	330	23	120	435	1.81	240	500	196
326	3872	440	-10	85	537	1.22	440	85	232
327	3.2	720	65	156	250	0.37	687	1440	-20
328	8.8	300	13	148	261	0.79	330	523	285
329	2.1	953	-10	240	238	0.34	714	952	-20
330	11.9	380	-10	60	-40		457	78	380
331	2.25	1780	-10	-40	578	0.65	890	267	-20
345	7.9	709	-10	177	-50		253	-40	-20
350	7.5	747	-10	147	-40		160	-40	20

SAGE ROOT

BP 217	13.8	652	-10	224	202	1	202	130	-20

TABLE IV

WATSON BAR, B.C.

		Ag (ppm)	Au (ppm)	As (ppm)	Hg (ppb)
1. PINUS CONTORTA - (Jackpine)					
#1T	1st year stems	6.93	1.01	24	
	" " needles	5.33	1.22	27	
#3	1st year stems	2.44	0.32	8(0.6)	
	" " needles	6.47	0.65	32(0.8)	
#1	1st year stems	6.72	1.50	57(1.2)	
	" " needles	4.80	0.91	17(0.4)	
#66Lee	1st year stems	7.37	0.49	10(0.2)	
	" " needles	5.64	0.56	26(0.5)	
#66MC	1st year stems	15.26	0.45	8(0.2)	260
	" " needles	10.74	0.56	20(0.4)	
#314	2nd year stems	2.7			
	" " needles	2.8			
	2nd year stems	0.7			
	" " needles	0.47			
#154	2nd year stems	5.9			
	" " needles	3.1			
2. PINUS PONDEROSA					
#66 Hedley					
	1st year stems	2.90	0.97	670(18.0)	
	" " needles	5.38	0.88	630(17.7)	
PINUS ALBICAULIS					
	1st year composite			2	350
PINUS FLEXILIS					
#66 Shannon					
	1st year stems	12.15	0.49	-	
	" " needles	6.15	0.37	51(1.5)	

3. EPILOBIUM AUGUSTIFOLIUM - (Fireweed)

	Ag (ppm)	Au (ppm)	As (ppm)	Hg (ppb)
1st year stems	4.97	0.19	12(0.7)	
" " leaves	3.35	0.22	17(1.5)	

TABLE IV Cont.

		Ag (ppm)	Au (ppm)	As (ppm)	Hg (ppb)
4. PSEUDOR SUGA MENZIESII – (Cont'd)					
#G Utica					
	1st year stems	5.47		21	
	" " needles	5.92		4	
#J7	2nd year needles	9.5		20	
J27	" " "	8.7		184	
J63	" " "	10.5		23	
#65 ATH.					
	2nd year stems	2.7		20	
	" " needles	2.3			
#243	2nd year stems	1.9			
	" " needles	1.6		12	
#298	2nd year stems	3.1			
	" " needles	2.6		10	
#59KO	2nd year stems	7.0			
	" " needles	4.4			
5. LUPINUS SP. – (Lupin)					
	1st year leaves	3.15	0.08	30	
	" " composite			4	530
6. ALNUS SP. – (Alder)					
#1	1st year leaves	4.30	0.48	10	
7. ABIES LASIOCARPA – (Alpine Fir – Mountain Fir)					
#A	1st year stems	13.29	0.64	–	
	" " needles	7.20	0.68	40(1.1)	
#2	1st year stems	4.89	2.10	–	
	" " needles	3.19	0.61	16(0.5)	
8. PICEA GLAUCA – (Mountain Spruce)					
#3	1st year stems	11.16	0.76	17(0.6)	
	" " needles	9.68	0.46	8(0.2)	
#4	1st year stems	13.22	0.63	9(0.4)	
	" " needles	12.33	0.63	7(0.2)	

TABLE IV CONT.

	Ag (ppm)	Au (ppm)	As (ppm)	Hg (ppb)
8. PICEA GLAUCA				
Picea Sp.				
1st year stems	5.83	0.65	7	
1st year stems	25.84	0.53	14(0.5)	
" " needles	4.77	0.65	9(0.2)	
#A 1st year leaves	10.53	0.54	6	
#B 1st year stems	4.67	0.64	28(1.0)	
" " needles	4.40	0.60	41(1.3)	
9. BETULA PAPYRIFERA				
#66 Shannon				
1st year stems	8.49	0.89	80(2.1)	
" " leaves	6.92	0.14	72(6.7)	
10. PSEUDOR SUGA MENZIESII - (Douglas Fir)				
#A 1st year stems	4.02	0.22	3500	
" " needles	4.74	0.35	570	
#66Lee 1st year stems	4.67	0.32	20(0.7)	
" " needles	4.59	0.30	13(0.5)	
#B 1st year stems	4.73	0.56	180(6.1)	
" " needles	4.59	0.29	64(2.5)	
#66Nick 1st year stems	4.48	1.02	1040(32.0)	
" " needles	3.45	0.47	240(9.7)	
#66 Hedley				
1st year stems	12.13	0.56	18800(707.5)	
" " needles	5.59	0.44	7900(340.0)	
#66 Trimble			50	400
1st year composite			38	290
11. SALIX - (Willow)				
1st year leaves	5.22	0.16	7(0.5)	400
Swamp Willow:				
1st year stems	4.93	0.77	35	
" " leaves	5.72	0.33	15	

An Attempt to Discover a "Carlin-Cortez" Type of Gold Deposit in British Columbia

By HARRY V. WARREN and JOHN H. HAJEK

ABSTRACT

Evidence is presented to show that there is in British Columbia an area where geochemistry indicates the presence of a "Carlin-Cortez"† type of gold deposit. In this type of deposit many of the gold particles are of submicron size, and become to some extent soluble and available to plants. Unfortunately, in the area under consideration, many difficulties beset both prospector and developer. A paucity of sulphides, a lack of outcrop and residual soils, and much glacial debris, including at lower elevations a layer of cemented glacial clay close to bedrock, all tend to render ineffective the usual exploration techniques and to make prospecting both difficult and frustrating. In some parts of the area biogeochemistry may provide a useful supplementary tool.

BACKGROUND

The production of gold at Carlin, Nevada, in 1965 ushered in a new type of gold mining, a happening that might well, in the fullness of time, prove to be as important a milestone in the history of gold mining as the first exploitation of a porphyry copper was in the history of copper mining.

Following the above event there came, during 1972, a significant rise in the free market price of gold from around $40 an ounce to more than $60, and in 1973 to $100 or more.

Unfortunately the discovery and delineation of ore bodies of this type pose some problems. The gold particles are so fine that not only are they seldom visible to the naked eye, but also they are extremely difficult to isolate with a gold pan. Furthermore, although the Carlin type of gold deposit may be associated with one or more of a number of elements, including mercury, antimony, arsenic, bismuth, tellurium, barium, and strontium, they are usually characterized by a relative paucity of sulphides, a fact that tends to make less effective than usual the more commonly used geophysical methods.

Thus, in any area where, in addition to the above mentioned problems, outcrops are rare, soils relatively young, and glacial debris, — including much compacted clay — is widespread, it is obvious that one must welcome any technique that can aid in discovering potential ore. This paper deals with one technique, geochemistry, and more particularly biogeochemistry, that at one locality in British Columbia has been useful in delineating mineralization.

HISTORY AND EARLY WORK

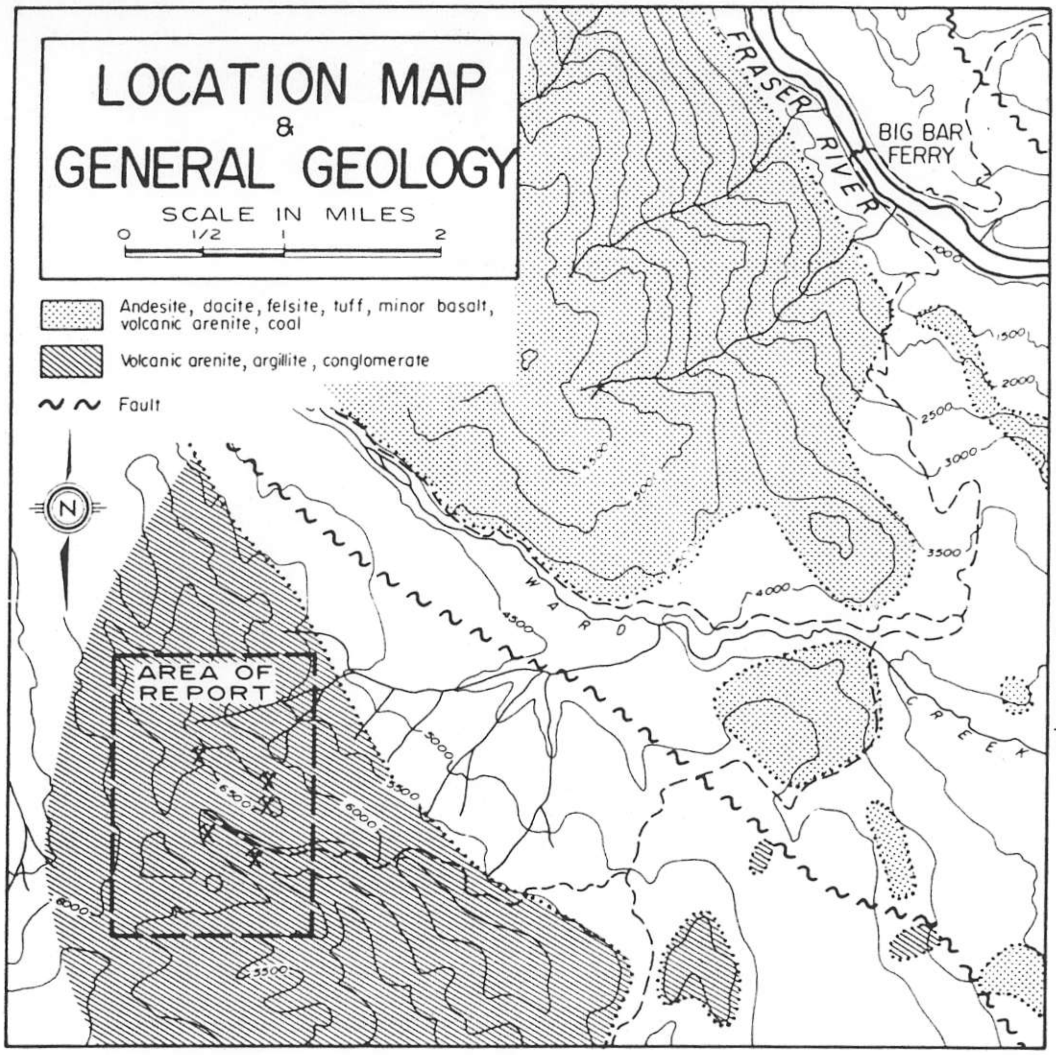
This study involves an area of considerably more than 1000 acres situated in southern British Columbia near the headwaters of Stirrup Creek which is located at latitude 51°07' and longitude 122° 15' within N.T.S. 92-0-1. Stirrup Creek is a northern tributary of Watson Bar Creek which flows east to join the Fraser River about six miles south of the Big Bar Ferry crossing. As the crow flies, Stirrup Creek lies approximately 28 miles due west of Clinton. However,

† A Carlin-Cortez type of gold deposit may be considered as an epithermal type of mineralization where vein development is relatively unimportant and finely disseminated gold occurs in replacement bodies predominantly in sedimentary rocks containing significant amounts of calcium and accompanied with anomalous amounts of barium, strontium, arsenic, antimony, mercury and copper.

Dr. Harry V. Warren

The senior author of this fine article, Dr. H.V. Warren is well-known to readers of "Western Miner" since many of his writings, comprising 150 technical articles, have appeared in the pages of this magazine. He was for many years a professor of geology at the University of British Columbia but retired earlier this year. The social occasion marking that "retirement" (for Harry is as active as ever in his chosen profession) was documented in the July, 1973 issue of Western Miner. It revealed, among other things that he received his education at U.B.C., Oxford University, which he attended as a Rhodes scholar, and later at the California Institute of Technology. He has received many distinguished awards and honors as a result of his work, both in the community and in the academic and engineering world where he is recognized as an authority on geochemistry.

John Henry Hajek was born in Brno, Czechoslovakia and educated in Paris where he received a B.A. in chemistry. He came to Canada in 1964. Since then he has been involved in mining exploration and worked in the Canadian Shield, the Yukon, British Columbia, Nevada, Utah, and Washington



PRELIMINARY DRILLING

At this juncture a more intensive and extensive geochemical investigation was planned. However, the discovery of some relatively high grade material at the bottom of one prospecting pit, — it ran a little better than 0.6 ounces of gold per ton, — resulted in a change of plans. In August, 1971, some exploratory percussion drilling was undertaken. A hindsight view suggests that this was most unfortunate. Nine two hundred foot holes by percussion drilling were planned. Seven were completed and two terminated prematurely because of unanticipated trouble with water. Nevertheless, 161 ten foot sections of sludge were collected and analyzed for gold with disappointing results, no single sample being of economic grade.

Fortunately the rejects from these samples were available and all were analyzed spectographically by D. Marshall, and a few of the samples were superpanned to see if the sulphides which had been reported during the drilling were in any way related to what gold was present in the samples.

Table No. 4 presents the results of these analyses in summary from parallel to the results given in Table No. 2.

The three samples containing the greatest concentrations of arsenic were superpanned and found to contain less than one percent of combined sulphides which ran more than 2000 ppm of arsenic and showed modest amounts of what were believed to by pyrite and stibnite. These tips ran as follows in gold: Not determinable, .25 ppm and 1.5 ppm. All contained silver but in amounts of less than 1 ppm. The sample containing .25 ppm of gold also carried a trace of bismuth.

Because several thousand pounds of the stibnite had been assayed previously and found to contain negligible amounts of gold, it now seemed safe to assume that any gold present in the Stirrup Creek area was not intimately, or even closely associated with pyrite, arsenopyrite, or stibnite. This is in direct contrast with the better known gold mining camps in British Columbia such as those in the Cariboo, Bridge River, Zabellos, Hedley, Boundary, Sheep Creek or Ymir areas.

The sample of high grade which had led to the decision to drill was then closely examined.

Although minute particles of pyrite and arsenophyrite were both tentatively identified, all the gold was observed as micron sized grains in late generation of quartz.

A study of the drilling logs has thrown little light on the relationship between the different elements and gold, but there is a crude relationship between anomalous gold and anomalous copper and arsenic and an inverse relationship between gold and barium, strontium, and antimony.

As a working hypothesis it would seem reasonable to suggest that when sufficient geological data become available, zoning and intersecting structures will be found to be the key factors in determining the locations of gold ore.

Two facts clearly emerge from all the above observations, namely, that at Stirrup Creek there are trace element concentrations and gold associations that bear many similarities to those described at Cortez by Wells, Stoiser, and Elliot (1969), and at Carlin by Radtke et al (1972). Based on empirical observations only the evidence presented at Stirrup Creek would appear to support the ideas of gold transportation discussed by Boyle, 1969. The abundance of calcium, barium and strontium, the intimate association of extremely fine particles of gold with late quartz and the close but not intimate association of gold with arsenic and antimony are all points of interest.

by road the distance from Clinton to Stirrup Creek via Kelly Lake, Jesmond and Big Bar Ferry is just short of 60 miles.

Stirrup Creek was the scene of one of the last placer mining camps to be discovered in British Columbia. Stirrup Creek flows in a generally southeasterly direction, and is paralleled in the northeast by Ward Creek, and in the northwest by Roderick Creek. Neither Ward Creek nor Roderick Creek have yielded more than scattered "colours" of fine gold but Stirrup Creek, in its whole length of somewhat less than four miles has produced between a quarter and half a million dollars of gold. By 1940 operations on Stirrup Creek had all but terminated. Bill Trimble, one of the earliest workers in the area, continued to prospect for the "Mother Lode", and Ernie Roseneau for a short time operated a bulldozer on the lower part of the creek and recovered some placer gold, but the venture was not a financial success.

Unfortunately, the upper two miles of Stirrup Creek and the immediate area surrounding the creek ranging in elevation from 5600 feet to about 7000 feet, except at numerous localities near the highest elevations, are completely masked by an overburden of soil and glacial debris. Furthermore, on the left or northern slopes, to an elevation of about 6200 feet, there is a layer of well cemented glacial clay which further impedes bedrock prospecting. This overburden normally ranges from one to ten feet in thickness.

Prospecting for the "Mother Lode" was carried on by panning samples from near the bottom of the creek and from numerous hand dug pits, by driving half a dozen short adits and by sinking one sixty foot deep winze. Old records show that values ranging from .3 to 1.18 ounces of gold per ton were encountered at the bottom of this winze, which is not at present accessible. A few tons from the bottom of this winze were treated in a primitive arrastra. Gold was recovered but this operation presumably was not successful because it was not continued. Erratic gold values were encountered in some narrow quartz veinlets one of which ran an ounce and a quarter of gold across three inches.

More recently ground sluicing has disclosed additional geological information, and although no ore bodies have been uncovered it has advanced the day when the riddle of Stirrup Creek will be solved.

One of the more recent cuts has revealed a narrow quartz vein showing visible gold associated with wehrlite, a rare silver bismuth telluride.

Another recent cut brought in sight a conspicuous fault along which can be seen as much as five feet of gouge which carries up to .08 oz. of gold per ton.

Other cuts disclosed plutonic rocks exposed over several areas on the right bank of Stirrup Creek and also uncovered some carbonated plutonic rock in which the femic minerals have been completed replaced by a carbonate mineral carrying particles of cinnabar. Selected samples of this latter material ran 0.2 per cent mercury. Two other cuts 1400 and 2200 feet away revealed similar but more weathered rock of the same original composition.

Although earlier work did not succeed in finding a gold ore body it did succeed, largely on a basis of panning, in outlining an anomalous gold bearing zone approximately 8000 feet long over a vertical range of about 1300 feet. The width of this zone has not been determined, but on the basis of inadequate data it appears to be from two to four hundred feet wide, but could easily be much wider.

The cuts provided other useful information. The presence of bands of carbonitized rock several hundred feet wide were demonstrated, and also some hydrothermal alteration. Furthermore, it became clear that unless the carbonitization was followed by a later period of silicification gold values were negligible although cinnabar mineralization might occur. Earlier work also uncovered irregular lenses of stibnite in three separate localities, and one concentration of barite, all of little or no direct economic importance, but all seemingly related to one or more well defined faults.

At this juncture work might have ended for an indefinite period because without more geological information it was difficult to see how further useful work could be justified, except at unacceptable cost.

Fortunately, new geochemical data became available in the 1960's and this materially changed the picture. However, before proceeding with recent developments a brief resume of the general geology of the area should be helpful.

GENERAL GEOLOGY

The headwaters of Stirrup Creek are occupied largely by a belt of sedimentary and volcanic rocks known as The Jackass Mountain, Group C Formation which is of Mid Lower Cretaceous Age. (Trettin, 1961).

These rocks are cut by numerous dykes and sills. Their age has not been established, but they are believed to be Late Cretaceous or Early Tertiary. They range in thickness from an inch to several feet. Many contain conspicuously weathering feldspar phenocrysts, a feature that led the early prospectors, some of whom arrived in the area after working in Colorado and Nevada, to refer to them as "Birdseye Porphyries". On the western side of the area numerous showings of plutonic rocks have been uncovered. They approximate quartz diorite in composition and what scanty evidence is available suggests that at least two distinct intrusions are involved. Because of the scarcity of exposed rocks the areal extent of these plutonics is not known.

The Jackass Mountain Formation consists largely of medium to coarse grained greywackes which are composed predominantly of feldspar, chert, and shale fragments in a fine grained calcareous arenaceous ground mass. Beds of grey argillites are interbedded with the greywackes. In the northeastern corner of the area, where it is drained by Ward Creek, there are several feet of conglomerate beds, boulders of which have been transported by glaciation into the headwaters of Stirrup Creek. The Jackass Mountain rocks in this area strike roughly east and west and dip north at angles generally between 10° and 25°. This attitude is believed to be consistent over most of the area investigated.

As has been mentioned, numerous faults can be observed. All are probably related to the principal Fraser River Fault, and in particular to a branch mapped by Trettin (1961) along the southwest side of Ward Creek and which divides the Jackass Mountain Formation, so prominent in Stirrup Creek, and a group of somewhat younger volcanic rocks conspicuous around Ward Creek and referred to by Trettin as The Ward Creek Assemblage. In age these faults are post Eocene and pre Miocene.

Most of the quartz veinlets and stringers so far observed seem to be nearly vertical and strike N. 30° E, whereas most of the major faults so far uncovered, run in an approximately E-W direction.

PRELIMINARY GEOCHEMICAL INVESTIGATION

Early in the 1960's it became obvious that if further development was to take place new evidence would have to be produced.

Water testing of Stirrup Creek was undertaken. The heavy metal content of Stirrup Creek in its upper reaches was from 10 to 25 parts per billion, but in three places downstream from where it was thought to be cut by faults it ran 49, 54, and 66 parts per billion respectively. First and second year stems of Douglas Fir trees in the hypothecated gold belt referred to previously, were analyzed for arsenic and were found to contain from 700 to 5000 parts per million in their ash instead of a normal 50 to 100 parts per million

It had previously been demonstrated that the vegetation in this general area carried gold (Warren and Delavault (1950). However, this knowledge had been considered to have only academic

TABLE 1

THE GOLD AND SILVER CONTENT OF DOUGLAS FIR NEEDLES
(In ppm. of Ash)

Sample Designation	Sample Location	Weight of Ash	Gold	Silver
1) 69 WB "A" 1st yr. needles	100' below 3420 Cut	5.9 grams	0	19
2) " " 2nd yr. needles	"	13.1 grams	38	10
3) " "B" 1st yr. needles	Near top of 3250 Cut	7.6 grams	62	14
4) " " 2nd yr. needles	"	13.9 grams	0	29
5) " "C" 1st yr. needles	100' below 3080 Cut	6.2 grams	0	83
6) " " 2nd yr. needles	"	11.6 grams	0	35

interest. Nevertheless, six samples of first and second year needles of Douglas Fir were collected and ashed to produce from six to fourteen grams each of ash and then fire assayed for gold and silver by S. Franklin under the supervision of a colleague, Professor Ian H. Warren, of the Metallurgy Department of the University of British Columbia. Blanks were run, and all possible precautions against salting were taken. Even so, the size of the samples proved too small for satisfactory work, and it seems most likely that the four zero gold values were the result of gold breaking up and being lost during parting. It seems highly probable, however, that the gold that was reported represents a satisfactory assay. The results obtained from these six samples are given in Table 1.

The above results led to a re-examination of all available rock samples. No gold was seen in any. However, under high magnification it is possible to distinguish arsenophyrite in some samples.

Thus by 1969 it was well established that over an area of at least 1000 acres there were several localities with rock which contained anomalously high concentrations of one or more of the elements gold, arsenic, antimony, barium,

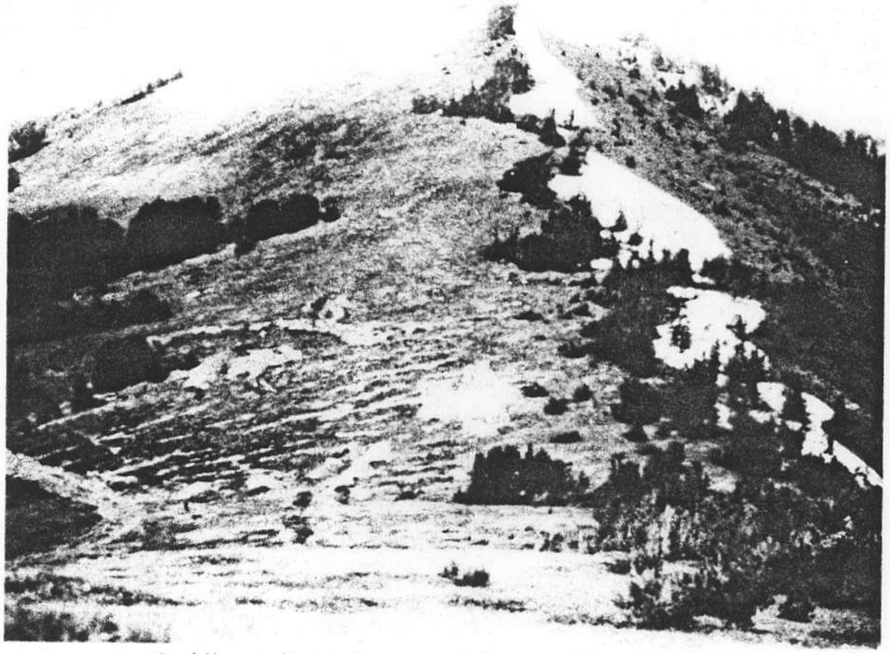
TABLE 2

EVIDENCE OF ANOMALOUS CONDITIONS AT STIRRUP CREEK
(All results given in ppm)

Element	Range	Median	Average "A" Lithosphere	Arbitrary Threshold	% above Threshold
Strontium	30-6000	575	150	800	23
Barium	30->10,000	500	430	1500	16
Copper	10-5000	200	100	501	15
Manganese	40-2000	750	1000	1000	21
Antimony	<50->10,000	<50	1	50	18
Arsenic	<200->10,000	<200	5	200	18
Mercury	0.1 - 33	0.35	<0.2 "B"	0.6	19

"A" Goldsmith, V.M. 1954. Geochemistry, Oxford University Press, Oxford, England, p.74

"B" Our estimate for this general area



Saddle at divide between Stirrup and Ward Creeks

TABLE 3

STIRRUP CREEK - SOIL PROFILES

Profile Number	Sample Number	Depth in Inches	Au in ppm	Hg ppm
#1	W 06	0-2"	0.3	3.33
	W 02	2"-6"	0.7	0.4
	W 03	6"-15"	0.6	0.3
	W 04	15"-36"	2.08	0.2
	W 05	36"-48"	0.85	0.25
#2	W 96	0-9"	< .02	< 0.04
	W 97	9"-18"	< .02	0.04
	W 98	18"-36"	0.15	0.12
	W 99	36"-54"	< .02	0.20
	W 100	54"-72"	< .02	0.16
#3	W 27	0-6"	0.04	1.68
	W 28	6"-18"	0.63	0.88
#4	W 77	0-3"	< 0.02	0.4
	W 78	3"-24"	< 0.02	0.1
	W 79	24"-36"	1.0	0.2
	W 80	36"-48"	< 0.02	0.2

mercury, bismuth, and tellurium.

ROCK CHEMISTRY

Taking advantage of various pits and trenches which had been dug to bedrock in widely scattered parts of the area, fifty eight rock samples were assembled. These samples were analyzed spectographically by D. Marshall in the geochemical laboratories of the University of British Columbia. The majority of these samples were composed of highly oxidized material and, with the exception of a few specks of chalcopyrite in half a dozen samples and two others that contained visible barite, no minerals which might have hinted at the resulting data were noted.

Table 2 summarizes the results obtained from the fifty-eight samples.

SOIL CHEMISTRY

Unfortunately anomalies do not constitute ore. Obviously more geological data had to be obtained. However, before submitting an environment to unnecessary disturbance it seemed both prudent and economic to carry out a soil sampling programme that if, as, and when bulldozing became necessary it could be kept to a minimum.

In order to establish the most efficacious plan for this soil sampling, four pilot profiles were made in different localities. It was soon found that the soils in this area are, in general, poorly developed and that precise designation of specific horizons is impractical. Table 3 summarizes the results that were obtained.

The data presented in Table 3 show that higher gold values are obtained neither on the surface nor necessarily close to bedrock, but rather in an intermediate or "B" horizon which extends variously from six inches to thirty six inches below the surface. It may or may not be significant, but it must be noted that this relatively sophisticated sampling appears to have given results that are contradictory to those obtained by all the earlier workers, who, as a result of panning, reported that they only obtained significant values from samples taken within a few inches of bedrock.

Do these seemingly conflicting results suggest that the relatively coarse gold obtained by panning represents residual gold, possibly transported by glacial action, and that the gold reported by us was deposited by some form of chemical action?

Although soil sampling provides useful information it is clear that the results should be treated with caution. However, between three and four hundred "B" horizon soil samples were taken over an area of 600 acres in a northern portion of the area which, on the basis of reconnaissance, sampling was deemed to be most promising. These samples were analyzed for gold, arsenic, antimony, and mercury. The results were encouraging.

Between twenty and thirty acres carried soil values of 0.5 ppm or more of gold, i.e., they were better than 100 times background; about one hundred acres contained 50 or more ppm of arsenic or some 15 times background; and that more than fifty acres ran 125 ppb or more of mercury, against a background of about 20 ppb. Anomalous antimony values appeared to be more restricted, being confined to relatively restricted areas adjacent to small lenses of stibnite which had been uncovered by a series of shallow trenches in two localities.

The above data lent further substance to the hypothesis that "Carlin-Type" mineralization exists in this area.

TABLE 4

EVIDENCE OF ANOMALOUS CONDITIONS OBTAINED FROM DRILLING SLUDGES
(In ppm)

Element	Range	Median	Lithosphere	Arbitrary Threshold	Percentage above Threshold
Strontium	100-1500	575	150	800	13
Barium	80-3000	650	430	1500	13
Copper	4-2000	100	100	500	11
Manganese	300-2000	600	1000	1000	6.5
Antimony	$<$ 50- $>$10,000	$<$ 50	1	50	31
Arsenic	$<$ 100- $>$10,000	$<$100	5	200	31

BIOGEOCHEMISTRY

Having failed to find ore on the basis of soil sampling, it seemed reasonable to make use of some plant material that had been collected but not previously assayed.

Four composite samples, two of White-bark Pine (Pinus albicaulis) and two of Douglas Fir (Pseudotsuga menziesii) were analyzed, using a modified "Lakin and Nakagawa" (1965) method. The results were as shown in Table 5.

The above findings are well in line with results reported by other workers as summarized by Jones (1970).

It was earlier noted that a conspicuous flowering plant grew abundantly along the sides of a road that ran from where the road from Big Bar Ferry to Stirrup first crossed into the Stirrup Creek drainage to where it reached a point close to where the high grade sample had been discovered, a road distance of about 8000 feet.

Composite samples were taken from forty-four localities in an effort to see if useful biogeochemical data could be obtained from this source. The results were so interesting that they are reported in full.

MOUNTAIN PHACELIA

Family — **HYDROPHYLLSCEAE**
Genus — **PHACELIA**
Species — **SERICEA**

This plant is a perennial with a heavy tap root and several stems. Almost all leaves are near the base of stems and are covered with silver coloured woolly hairs, and have deeply cut margins. Flowers are bell shaped with stamens often protruding two to three times as far as the petals of the flower itself. Flowers occur in dense terminal spike-like inflorescence, purple in colour, with numerous seeds in a dry pod.

It occurs at moderate to high elevations from southern British Columbia and Alberta to Washington, Eastern Oregon, north-east California, Nevada, and Colorado. Related species, some of which grow at lower levels, are also tap rooted and found over a wider range in North America. Thus, this species offers interesting possibilities to prospectors.

Our results have demonstrated that if sampling is done during summer or autumn, it is not necessary to disturb the roots of this plant or even to use more than two, or at the most three, ounces of leaves or flowers to obtain one sample adequate for gold and tellurium analyses. Thus this type of biogeochemical sampling at a preliminary stage of exploration can obviate some mutilation of the environment that might be caused by open pits and tenches.

Initially it was not known how much sample would be needed and eventually some samples had to be combined in order to obtain reproducable and meaningful results.

Tables 6 and 7 must speak for themselves.

Areas "B" and "D" and part of "A" contain determinable quantities of gold which we consider to be background values, i.e., between 0.01 and 0.10 ppm in dry plant. Anomalous values are thought to be 0.2 ppm and higher. They are represented by areas "C", "E", and part of "A".

Areas "B" and "D" have not been systematically soil sampled, but on the basis of sporadic soil, sampling and panning results reported by previous workers they probably represent soil samples running less than 0.1 ppm in the "B" horizon. The samples from "A" area were taken over a distance of about 600 feet, but at one point were taken only 300 feet down hill from the high grade rock sample referred to earlier in this paper. Area "C" is within three hundred feet of the winze from which earlier workers had reported finding ore grade samples.

The finding of tellurium in every sample opens up new avenues of thought. Does this tellurium merely complement the discovery of wehrlite by us and repeated reports of the presence of tellurium by the late "Bill" Trimble? Alternatively, does this suggest the possible presence of precious metal tellurides? Precious metal tellurides when they weather provide "flour" gold, which is difficult to pan but like the fine gold already mentioned could well provide gold in a form that could be taken up by vegetation.

SUMMARY

Unfortunately, on the evidence presently available it is still impracticable to construct any coherent geological map. However, it does seem safe to state:

(1) That within an area embracing at least from 1000 to 1500 acres there are substantial amounts of soil carrying more than 0.5 ppm of gold.

(2) That between 15 and 25 per cent of randomly selected rock samples taken from prospect pits and tenches carried anomalous amounts of barium, strontium, copper, manganese, antimony, arsenic, and mercury.

(3) That of the 161 samples obtained from drilling sludges only from 11 to 13 per cent were anomalous in strontium, barium, and copper, but 31 percent were anomalous in either arsenic or antimony or both: 65 per cent were anomalous in manganese.

(4) That gold is associated with a late generation of quartz and is related but not intimately tied to arsenopyrite or

TABLE 5

GOLD CONTENT OF SOME EVERGREEN STEMS
(in ppm ash.)

Species	Age	Organ	Location	Gold Content
White Pine	1st yr.	Stem	Vicinity of Trimble Tunnel	0.50
" "	2nd "	"	" " " "	0.60
Douglas Fir	1st yr.	"	" " " "	0.55
" "		"	" " " "	0.50

TABLE 6
GOLD CONTENT OF MOUNTAIN PHACELIA
(in ppm of oven dried material)

Sample No.	Flower	Stem	Flower and Stem	Leaf and Stem	Leaf and Base	Lower Base	Root	Lower Base and Root	Range	Average
Area A										
809		.20		.25	.20	.20			.20- .25	.21
810	.21	.36			.10	.36			.10- .36	.26
811,812			.20					.04	.04- .20	.12
813	.09	.03	.09						.03- .09	.07
814			.10					1.05	.10-1.05	.57
815				.02				.11	.02- .11	.06
816,817,818				.12	.06	.05	.09		.05- .12	.08
819,820,821					.13	.10	.08	.12	.08- .13	.11
822	.04	.04	.05	.03					.03- .05	.04
823,824,825				.05	.02	.01	< .01	.06	< .01- .06	< .03
826	.04	.02							.02- .04	.03
827,828	.02	.05		.08	.05			.01	.01- .08	.04
Area B										
829,830,831	.02	.01		.03	.02	.03	.03	.03	.01- .03	.02
832,833	.02	.09	.02		.04			.05	.02- .09	.04
834,835	.13	.10	.14	.06	.08	.08		.06	.06- .14	.09
836,837	.03	.02	.08	.05				.05	.02- .08	.05
838,839	.05	.05		.02				.02	.02- .05	.03
Area C										
801		.32	.34	.10		.20			.10- .34	.24
75	.15		.29		.15	.20			.15- .29	.20
802		.30			.20				.20- .30	.25
803		.34		.15		.20			.15- .34	.23
804,805,806		.30	.32	.20		.16		.15	.15- .32	.23
Area D										
842,843	.03	.02	.05		.06			.01	.01- .06	.03
840,841	.03	.03			.01			< .01	< .01- .03	< .02
Area E										
807				.13				.53	.13- .53	.33
808			.46	.13		1.20			.13-1.20	.60

pyrite. Further work may well reveal that there is zoning and some halo relationships between gold and these other anomalous elements.

(5) That in localities where there have been concentrations of either antimony, mercury, or barium, gold values have been minimal in the immediate vicinity.

(6) That within the area studied, biogeochemistry has largely been responsible for adding tellurium to the list of elements present in anomalous amounts.

(7) That until more geochemical and geological data are available it will be impossible economically to outline by drilling any ore that may be present.

CONCLUSIONS

Abundant geochemical, mineralogical, and geological evidence supports the belief that mineralization of the "Carlin-Cortez" type occurs in an area of several hundred acres at the head of Stirrup Creek in Southern British Columbia.

Generous samples of ore grade rock have been uncovered but preliminary drilling conspicuously failed to discover any ore.

Biogeochemistry has been successfully used to correlate anomalous concentrations of gold and arsenic in plants with anomalous concentrations of these elements in rocks. Mountain phacelia has also served to indicate the widespread occurrence of modest amounts of tellurium, a fact heretofore not fully appreciated.

Further work must be carried out if ore is to be found, but it is the opinion of the authors that further effort is fully justified.

ACKNOWLEDGMENTS

The authors have had much help in assembling this paper. Some of this study was carried on as part of a widespread program supported by N.R.C. Grant No. A3563 dedicated to finding disseminated gold, and silver deposits in Western Canada. Rio Tinto Canadian Exploration Limited, who gave up an option on claims in this area, after they had disappointing drilling results, provided us with all their accumulated knowledge and allowed us to analyze all the sample rejects. Kennco Explorations (Western) Limited provided us with invaluable assistance by carrying a large number of gold, arsenic, antimony, and mercury analyses and Mr. C.S. Ney helped with valuable advice and suggestions.

Stirrup Creek is well known to many people and has had the distinction of being "turned down" by many competent geologists. However, two men in particular offered positive encouragement in the past, namely the late Dr. W.E. Cockfield of the Canadian Geological Survey, and the late Dr. Jack Gower of Kennco Explorations Limited. Without their advice and guidance the senior author would never have persisted in what at one time looked like a fruitless endeavour. However, with the development of various new aspects of geochemistry and voluntary help from partners and many friends, more and more information became available. Eventually a project which had originally represented a useful academic exercise became a potentially viable operation.

In 1950 the B.C. Department of Mines provided a Grant of $2500 which made possible the building of a road from Big Bar Ferry to the upper part of Stirrup Creek.

TABLE 7

TELLURIUM CONTENT OF MOUNTAIN PHACELIA
(in ppm of oven dried material)

Sample No.	Flower	Stem	Flower and Stem	Leaf and Stem	Leaf and Base	Lower Base	Root	Lower Base and Root	Range	Average
Area A										
813	.45	.40	1.70						.40-1.7	1.3
814			.62				1.0		.62-1.0	.8
815				.90				.35	.35- .9	.6
816,817,818				.50	.40	.50	.25		.25- .5	.4
819,820,821					< .05	< .05	.66	.70	<.05- .7	<.4
822	.70	.40	1.0	.73					.4 -1.0	.7
823,824,825				.30	.30	.12	.25	.35	.12- .35	.3
826	.45	.38							.38- .45	.4
827,828	.25	.26		.25	.26			.30	.25- .3	.3
Area B										
829,830,831	3.00	.60		.26	.45	.30	1.0	.30	.26-3.0	.8
832,833	.80	1.60	.40		.06			.80	.06-1.6	.7
834,835	> 3.50	1.60	> 3.50	1.20	< .05	< .05		< .05	<.05- 3.5	1.2
836,837	.10	< .05		< .05				<.05	<.05- .1	< .1
838,839	< .05	.50		1.60				.70	<.05-1.6	.7
Area D										
842,843	.50	.80	2.0					.60	.5 -2.0	1.0
840,841	1.00	.80			1.40			.75	.75-1.4	1.0

When geochemical techniques were relatively primitive many individuals and companies assisted us by running check analyses. To all of the above the authors gratefully acknowledge their indebtedness.

EDITOR'S NOTE

The authors wish it to be stated clearly that there are good grounds for saying that they are faced with a conflict of interests in presenting this report. The senior author (HVW) has been involved for some years in trying to evolve ways and means of using geochemistry to aid in locating epithermal gold and silver deposits of the "Carlin-Cortez Type". The junior author (JHH) has had the good fortune to visit and work around both the Carlin and Cortez properties. However, the senior author, together with several partners have an interest in the territory being dealt with in this paper, having originally staked claims there in 1942. The junior author, who in 1970 and 1971 was working for Rio Tinto Canadian Exploration Limited, participated in preparing a report which recommended that further work be done in this area, although he was not present when drilling was undertaken.

The authors have attempted to be as objective as possible in preparing this report, but whether or not they have succeeded in being so must be decided by their readers.

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Reprinted from WESTERN MINER issue of October, 1973