

DOLMAGE CAMPBELL & ASSOCIATES LTD.
CONSULTING GEOLOGICAL & MINING ENGINEERS
1000 GUINNESS TOWER
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Tapin Copper Mines Limited (N.P.L.)

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Summary Report

RADIOACTIVE BLACK SANDS IN MALLOY AND VOWELL CREEKS
Bugaboo Area, B.C.

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SUMMARY

Tapin Copper Mines Limited (N.P.L.) owns 21 placer leases on Malloy and Vowell Creeks in the Bugaboo area of eastern British Columbia. Creeks in this area which drain from the Bugaboo and Horsethief batholiths have been known since 1953 to contain sands and gravels substantially enriched in radioactive black sands. Previous exploration work by various companies indicated Malloy and Vowell Creeks to have the best economic potential in the area and consequently detailed exploration, consisting of drilling (98 holes) and sampling, was concentrated on the most favourable areas (near the headwaters) of these two creeks.

Field exploration of the potentially economic deposits was adequate but unfortunately assaying was done on less than 20% of the samples obtained. This resultant sparse information does not allow confident interpretation and correlation of the deposit reserves. However, within the data limitations, Mr. J.M. Black, P.Eng., has made a reasonable calculation of the reserve potential on each creek:

	<u>Volume</u> <u>(cu. yds.)</u>	<u>U₃O₈</u>	<u>Nb₂O₅</u> <u>(Pounds per cubic yard)</u>	<u>ThO₂</u>	<u>Magnetite</u> <u>Ilmenite</u>
Malloy Creek	12,200,000	0.039	0.165	0.116	13.5
Vowell Creek	12,750,000	0.038	0.25	0.056	10

The gross value of this material at \$20. per pound uranium and current prices for the other constituents, with no allowance for recovery efficiencies, is approximately \$1.20 per cu. yd.

There is little doubt that Malloy and Vowell Creeks contain appreciable volumes of sand and gravel enriched in radioactive black sands. However, further work is required to determine if the deposits are economic. This work should consist of analyzing the previously collected but not analyzed drill samples, installing and operating a pilot plant at the deposits, undertaking mineralographic and metallurgical studies (preliminary work has been done in these areas), and conducting marketing studies.

The deposits on Malloy and Vowell Creeks thus require considerable work to determine their economic probabilities but the results of exploration work to date suggest that such efforts are warranted.

INTRODUCTION

Minerals containing uranium, niobium and rare earths have been known to occur in placer deposits in the Bugaboo area since 1953. Since that time, a number of companies have conducted exploration in the area but, for various reasons, none have managed to bring the deposits to production. With the present high cost of energy and consequent search for alternate sources as well as relatively high metal prices, Tapin Copper Mines Ltd. believes that the placer deposits should be reassessed at this time. Therefore, the purpose of this report is to assess the results of the various explorations and to recommend the direction which should be taken by subsequent exploration and research on the deposits.

LOCATION: (Figure 1)

Malloy and Vowell Creeks are located some 60 miles east of Revelstoke in the East Kootenay district of British Columbia. Both creeks drain northwards from sources in the Bugaboo granitic batholith; the radioactive placers occur near their headwaters between elevations of 5000 and 5500 ft. They are accessible by about 35 miles of dirt and gravel road from Spillamacheen in the Rocky Mountain Trench. ^{15 miles of} Temporary roads built along both creeks in the placer areas have probably been washed out. Landing sites for helicopters are plentiful on creek bars and swampy meadows.

had several minor landslips and wash-outs but could be quickly repaired by a bulldozer.

PROPERTY: (Figure 2)

The property consists of 21 placer leases, ⁷ on Malloy Creek and ¹⁴ on upper Vowell Creek as listed below.

Malloy Creek

?

Brsy #1
Malloy # 1-7

Vowell Creek

Brsy # ¹ - 14

HISTORY:

In 1953 uranium oxide and pyrochlore were identified in post glacial placer sand and gravel deposits in upper Bugaboo Creek. This and a similar deposit on Forster Creek some 10 miles to the southeast were mapped and extensively explored by churn drilling by Québec Metallurgical Industries from 1954 to 1957. In 1957 application for a contract to produce uranium was turned down by the Canadian government and the leases held in the area were allowed to lapse.

No further work was done in the area until, following restaking in 1966 and 1967 of the upper Bugaboo Creek and the Forster Creek deposits, an airborne spectrometer survey was conducted in the area during September, 1968. This survey, under the direction of Dolmage Campbell & Associates Ltd., located a number of anomalous areas on several creeks. ^{Jan 1968} Ground scintillometer surveys and visual estimates of relative gravel quantities in these several anomalous areas indicated that Malloy Creek and upper Vowell Creek had the best potential for containing economic deposits. ^{in late 1968} The ground was acquired in these two areas and detailed exploration carried out in 1969 by Dillingham Mining Co. The work consisted of drilling the favourable areas and doing some metallurgical testing.

ORIGIN AND CHARACTER OF THE DEPOSITS

The radioactive placer deposits of the Bugaboo area have been derived by post-glacial erosion of the Bugaboo and Horsethief batholiths and the consequent deposition of the resultant sands and gravels in the locally overdeepened valleys. Testing by churn drilling in 1954 (Bugaboo, Forster and Vowell Creeks) and by Becker drilling in 1969 (Malloy and Vowell Creeks) indicated that the placers contain a large black sand fraction concentrated from minor constituents of the granites. Although some discrepancies occur between the various data sources, it appears that the following minerals are present in the sands:

Allanite	Zircon
Magnetite	Rutile
Apatite	Monazite
Titanite	Uraninite
Ilmenite	A Titano-niobate

METALLURGY:

Metallurgical testwork has been conducted on the black sands but in only a very limited manner; consequently, the results should be considered only as indications on which to base further testwork. Indicated recoveries for niobium and uranium as determined by Quebec Metallurgical Industries are 75% and 80% respectively. However, the data do not give the grade of the sampled gravels or of the contained black sands. Testwork for Dillingham suggests that the minerals allanite, rutile, zircon, monazite and an unidentified titano-niobate, (possibly pyrochlore), could be recovered in a sink-float process and that this concentrate could contain 2.25% U_3O_8 , 6% Nb_2O_5 , 2.5% ThO_2 , 6% cerium, and a number of other rare earths. The niobium apparently occurs as niobium-bearing rutile and as the unidentified titano-niobate. Some of the uranium and thorium also occurs in the titano-niobate with the bulk of the thorium associated with monazite.

POTENTIAL RESERVES

Exploration of both the Malloy Creek and Vowell Creek deposits was done in adequate detail in the field but subsequent sample analyses were too few for the volume of deposit covered. The deposits were drilled along lines transverse to the valley trends. The lines were spaced at approximately 1000 ft. intervals with holes along them at about 400 ft. intervals. A total of 98 holes were drilled (including 21 in 1954); 38 on Malloy Creek and 60 on Vowell Creek. Hole depths varied from 8 feet to 95 feet and totalled 2160 feet on Malloy and 2723 on Vowell. The holes were generally sampled at four foot intervals with the result that over 1200 samples were collected. All of the samples were "field-concentrated" and the resultant black sands sent for analyses. However, less than 20% of the samples, (about 225), were analysed and then by the semi-quantitative X-ray fluorescence method. Comparison with results obtained by the fluorimetric method indicates the X-ray fluorescence results to be approximately 50% high for uranium. The precision of fluorimetric assaying is excellent for uranium grades below 0.10%, and virtually all of the results for Malloy and Vowell Creeks lie in this range, whereas X-ray fluorescence results tend to be inconsistent and biased (in this case 50% high).

GRADE:

The determination of average grade of the deposits is difficult and the results suspect because of the rather sparse number of samples which were assayed and the imprecise method of analysis. Compounding the problem are "cut-off" grades, the multi-mineral and element content, recoveries, mining limits, etc. However, calculations made by J.M. Black, P.Eng., for Dillingham Mining Co., done in some detail, appear to be as representative and meaningful as can be expected considering the limitations noted above. The grades, in pounds per cubic yard, determined by Mr. Black are:

	<u>U₃O₈</u>	<u>Nb₂O₅</u>	<u>ThO₂</u>	<u>Magnetite</u>	<u>Ilmenite</u>
Malloy Creek	0.039	0.165	0.116	13.5	1
Vowell Creek	0.038	0.25	0.056	10	3

At \$20. per pound for uranium and current prices for the other constituents, these grades average slightly more than \$1.20 per cubic yard, of which two-thirds is uranium value. This represents a gross value of the gravels, with no allowance for efficiencies of metallurgical recovery from them.

VOLUME OF DEPOSITS:

The calculation of potentially mineable sands and gravels is complicated by many of the same factors affecting grade determinations. Unfortunately, the rather sparse analyses data has an even greater detrimental effect on determining mining limits than on grade calculations. Indications of potential volume, employing the present data, can be obtained in a number of ways. Calculations can be made for the volume of all sands and gravels that: are derived from granitic rocks; have a relatively high proportion of black sands; have a relatively high scintillation count; or, that contain one or more metal and/or mineral value above some cut-off grade. The last method would appear to be the most useful but is also the most prone to various types of bias (cut-off grade, analyses inaccuracies, personal bias, etc.) which could have a very large effect on the results. However, calculations done by Mr. Black, in which he employed the assay results to determine mining limits, appear to be reasonable within the limitations noted. They are presented below as an indication of the reserves which may be present along the two creeks.

Malloy Creek	12,200,000 cu. yds.
Vowell Creek	<u>12,750,000</u> cu. yds.
Total (approx.)	<u>25,000,000</u> cu. yds.

CONCLUSIONS

The Bugaboo area of eastern British Columbia encompasses a number of creeks along which radioactive heavy sands have been deposited. Airborne and ground radiometric surveys completed in 1968 and 1969 indicated that two creeks, Malloy and Vowell, had the best potential for containing economic mineral deposits of, principally, uranium and niobium. Detailed exploration of the anomalous areas along these two creeks has indicated, with little doubt, appreciable volumes of post-glacial sands and gravels containing significant quantities of radioactive, heavy sands.

The grade and volume of this potential resource are difficult, from present data, to determine with as much confidence as would normally be desired in a placer deposit. The deposits have been adequately drilled but too few of the resultant samples have been analyzed, (less than 20%). Although a few samples from virtually all holes were assayed, and thus there is a sparse sampling throughout the deposits, there could still be lensing or stratification that would not be apparent because of the paucity of assay results. The information is thus too sparse to allow confident interpretations and calculations. However, some indication of grade and volume of the deposits is required; a calculation by J.M. Black, P.Eng., is reasonable considering these data limitations:

	Volume (cu. yds.)	U ₃ O ₈ (Nb ₂ O ₅	ThO ₂	Magnetite	Ilmenite
		Pounds per cu. yd.				
Malloy Creek	12,200,000	0.039	0.165	0.116	13.5	1
Vowell Creek	12,750,000	0.038	0.25	0.056	10	3

Gross value of this material at \$20. per lb. uranium and current prices for the other constituents is approximately \$1.20 per cu. yd.

Mineralographic and metallurgical studies are incomplete but do indicate the direction for further testwork. Marketing studies should be conducted along with such testing because some mineral products may be difficult to market and thus of little or no economic importance to the proposed operation. The best values, as noted above, appear to be in uranium and niobium. Also, some revenue may be realized from other products such as zirconium, etc. that occur in the concentrate.

*more assays
 could be done
 if need as every
 1' section of each
 hole was sampled
 - 50-100 lb. coarse
 gravel sample than
 reduced by Denver
 rot. Screen to 1-2 lbs (±)*

*As 10-13.5 lbs magnetite
 per cu yd contained, this could be
 possibility of market value - as possible
 still build for BC or offing.*

A problem which could arise, even in this rather remote area, if exploitation of the deposits is undertaken, is the impact on the environment with respect to public opinion. It will probably be necessary to rehabilitate all mined areas, a cost which should be included in all economic considerations.

RECOMMENDATIONS:

It is understood that the samples which were not analyzed may still be available. If so, they should be assayed for uranium and niobium by a reliable process such as fluorimetric analysis. Further assaying for other potentially economic constituents can be done at a later time.

Bulk testing should be undertaken at the deposits, in essence, a pilot plant operation to determine the feasibility of obtaining required concentrates and as a means of bulk sampling the deposits.

Mineralographic and metallurgical testwork on the black sand concentrates is required as a further refining of the process and determination of saleable products.

Marketing studies will be necessary, in conjunction with the above testwork, to determine the type, grade, quality and price of potential products.

The deposits on Malloy and Vowell Creeks still require considerable work and study to determine economic probabilities. However, results of the exploration work to date suggest that such efforts are warranted since a relatively large reserve of a potentially valuable mineral product exists in the deposits. Furthermore, with higher metal prices, other creeks in the area may contain potentially economic deposits as well.

Respectfully submitted,
DOLMAGE CAMPBELL & ASSOCIATES LTD.

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