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Geologic Report
PC 85-1
C. J. Freeman
November 1985

DAN L.
JAY E F

PRELIMINARY GEOLOGIC REPORT

PHELAN CREEK PLACER

PROSPECT, ALASKA

INTRODUCTION

The economic geology of the Phelan Creek placer prospect is presented in this preliminary report in an attempt to organize, clarify and analyze existing data as well as to determine the most cost effective exploration and development for the prospect. A brief description of the available geological and geochemical information will be followed by recommendations for future work on the prospect.

LOCATION AND ACCESS

The Phelan Creek placer prospect is situated on the glacial outwash plane of the Gulkana and College glaciers in the central Mt. Hayes quadrangle in the east-central Alaska Range, Alaska (Figure 1). The prospect is accessible via the paved Richardson Highway to a maintained gravel road just south of the summit of Isabel Pass (el. 3076'). The prospect is situated in the abandoned valley of upper Gulkana River; the headwaters of the Gulkana River have been captured by the headward migration of Phelan Creek which now forms the main drainage basin for the prospect. The prospect is located on a broad, flat plane at the toe of the two glaciers mentioned above. Elevations range from 3000 to 3500 feet. The prospect is unique among Alaskan placer prospects in that it is void of vegetative and soil (loess) cover. Phelan Creek, a tributary of the Delta River, is of sufficient volume to support moderate to large operations. Phelan Creek does not support aquatic life due to its high content of glacial "rock flour"; Phelan Creek is not a navigable stream nor is it used as a recreational stream for canoeing or kayaking.

CLAIM STATUS

The Phelan Creek prospect is composed of twenty-one contiguous State of Alaska mining claims owned by Mr. Joseph Taylor, P.O. Box 80814, Fairbanks, Alaska 99708. All claims are recorded in the Chitina Recording District. The only other claim owner on Phelan Creek is Mr. Wally Blasingame, P.O. Box 56673, North Pole, Alaska 99705. Mr. Blasingame

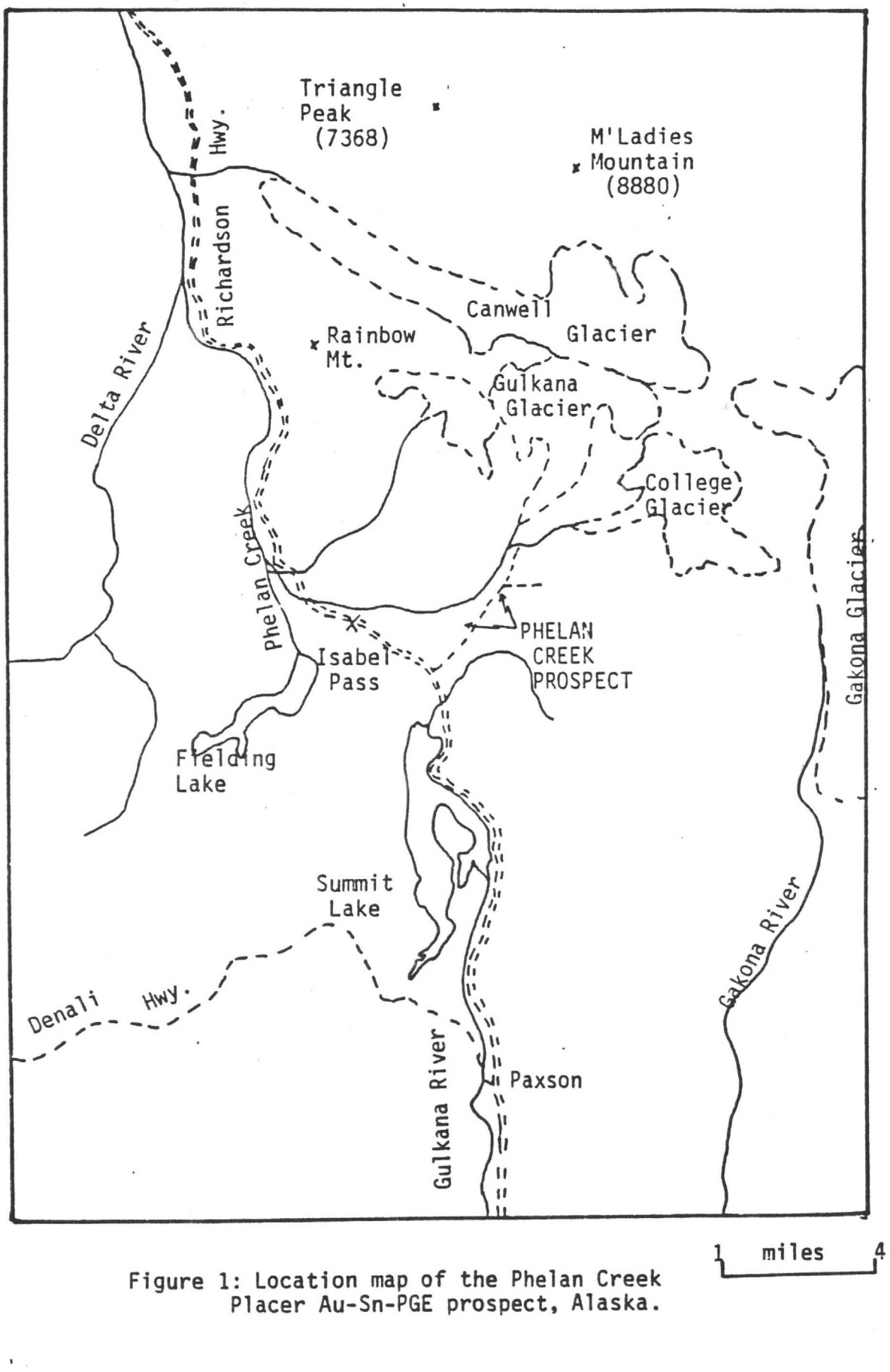

Figure 1: Location map of the Phelan Creek Placer Au-Sn-PGE prospect, Alaska.

controls a block of claims below the Taylor claims on Phelan Creek. A more complete land status report will be forthcoming.

PREVIOUS WORK

Only minor amounts of placer exploration and development work have been conducted on or near the Phelan Creek prospect in past years. Approximately 500 cubic yards of bank run gravel were run through a test sluice box by Mr. Dan Jensen who held an exploration lease on the prospect several years ago. No information is available on the exact quantity of free gold won from the test run gravels. However, the present owner extracted samples of the heavy mineral concentrates after free gold was removed from Mr. Jensen's sample run as well as from various samples collected in the last several years. The results of geochemical analyses on the heavy mineral fraction are discussed in this report (See "MINERALIZATION"). Yardage calculations computed by the owner indicate mineable reserves in excess of 100 million cubic yards on the prospect.

GENERAL GEOLOGY

The Phelan Creek placer prospect is situated approximately six air miles south of the trace of the Denali Fault within the fault valley of a large northeast trending terrane boundary fault which is marked by the valley of the Gulkana River (Figure 2). The fault trace separates northwest trending Pennsylvanian and Permian volcanic, clastic and carbonate rocks of the Tetelna Volcanic Complex and Mankomen Group on the west from north and northeast trending volcanic, clastic and carbonate rocks of the upper Tetelna Volcanic Complex, Mankomen Group and Triassic Nickolai Greenstone Formation on the east. Cretaceous age granodiorite to diorite plutons intrude the complexly faulted and folded country rocks. Intrusive rocks are most voluminous in a belt of northwesterly trending bodies which form the headwalls of College, Gulkana and McCallum glaciers. Country rocks in the vicinity of the prospect are only weakly metmorphosed; remnant volcanic and sedimentary textures are well preserved.

A series of northwest trending high angle faults dissect the terrane west of the Gulkana River fault. Time-stratigraphic equivalent rocks east of the Gulkana River fault exhibit northerly trends on the south side of the projected extension of the Slate Creek fault, a regional scale fault well mapped in the area ten miles southeast of the Phelan Creek prospect. North of the Slate Creek fault, high angle faults trend northeast. Faulting on the east side of the Gulkana River fault has preserved sections of the mafic volcanics which

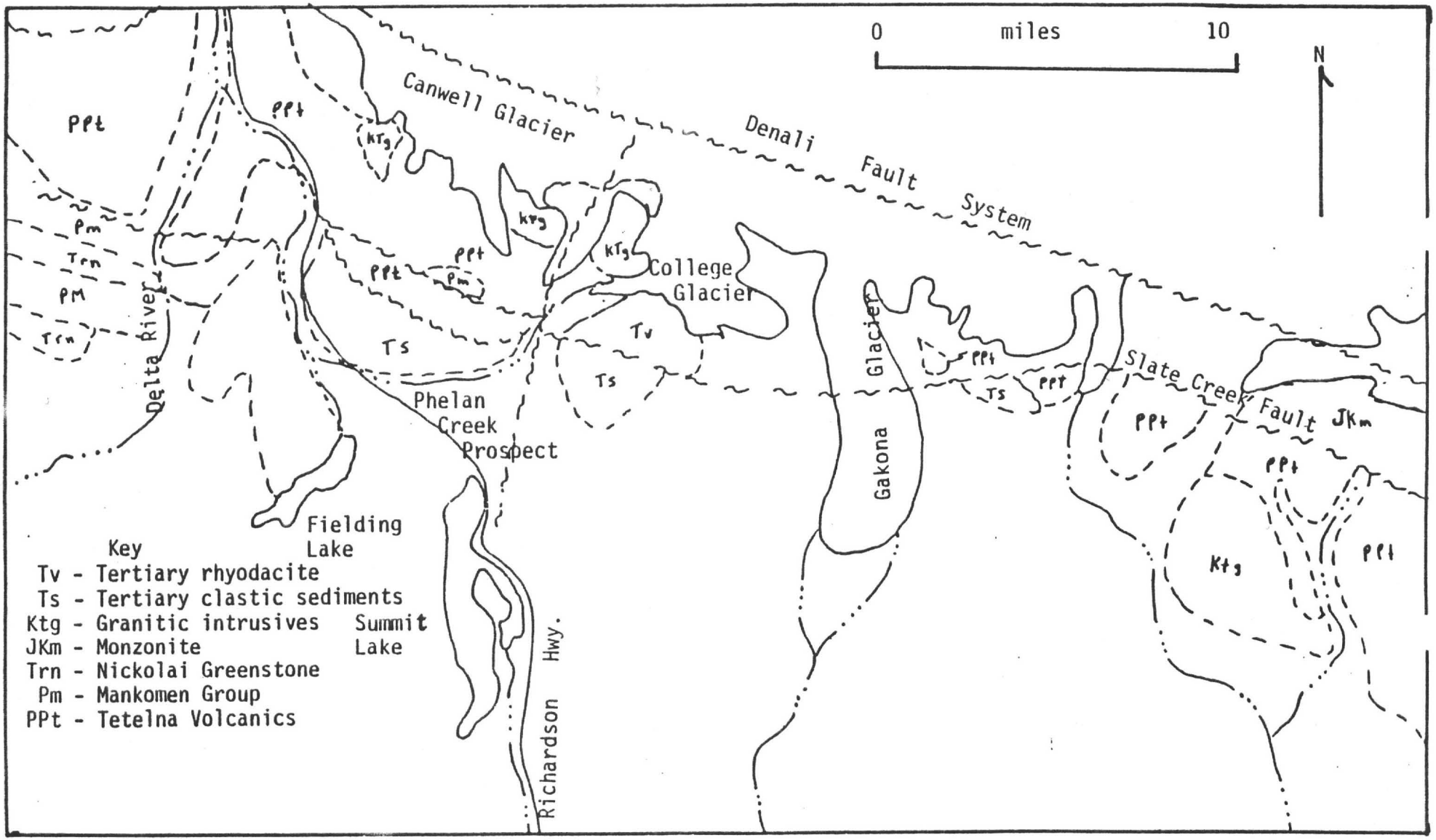

Figure 2: Regional geology of the Phelan Creek placer prospect and vicinity. Data from Bond (AkDGGS, GR-45, 1976).

characterize the Nickolai Greenstone terrane, a stratigraphic package which is host to the Nabesna Cu-Au skarn and numerous other Cu-Au-Ag prospects south of the Phelan Creek prospect.

MINERALIZATION

The Phelan Creek prospect contains three potentially recoverable metallic commodities, an aspect which significantly increases the economic viability of the prospect. Free gold is the most important metal in gravels from the prospect. Gold particles viewed under magnification exhibit only moderate to minor amounts of wear; wire and dendritic textures are retained in some specimens attesting to an apparently nearby source for the gold. Recent geochemical and microscopic analyses have indicated the presence of unknown quantities of cassiterite (tin ore, SnO_2) and as yet poorly understood occurrences of platinum group elements (PGE's). Electron microprobe analyses of concentrates from the prospect revealed significant relationships which go a long way toward understanding the metals in the Phelan Creek prospect. The majority of the heavy mineral concentrate (80-90%) was composed of rounded to subangular dodecahedral magnetite with a variable ilmenite or titano-magnetite content. Lighter box concentrate fractions were composed primarily of brittle brassy yellow pyrite and lesser chalcopyrite. Very light box concentrates were composed of material which returned elevated tin values. Thus by simple gravity separation, three separate metallic fractions can be seen to exist in Phelan Creek gravels.

In an attempt to further determine the residence sites of the Au, Sn and PGE's in Phelan Creek concentrates, magnetic and non-magnetic fractions of gold-free heavy mineral concentrates were analyzed by microscopic and fire assay techniques. In this test, conducted by the U.S. Bureau of Mines (Sample AK-17777), a 107.8 gram sample of homogenized box concentrate was first separated by low intensity magnetic methods to produce a magnetic fraction (93.2 gms) and a non-magnetic fraction (14.6 gms). Fire assays of the two fractions as shown in Table 1.

As is obvious from the assay results, a significant amount of gold and PGE's remains in the non-magnetic fraction of the concentrates. These same sample fractions were subsequently analyzed under a petrographic microscope to ascertain if the high gold values in the non-magnetic fraction were due to unrecovered native gold or if the gold values resulted from some other mineralogical species. The results indicate that the majority of the non-magnetic fraction is composed of pyrite with minor amounts of cinnabar, scheelite, bismuthinite, cassiterite and galena. One grain of tellurobismuthite (Bi_2Te_3) and one or two grains of HgAu amalgam were also seen in the non-magnetic fraction. Although one sample is hardly

TABLE 1

Fire Assay Results, Sample AK-17777, Phelan Creek Placer Concentrates. All values in opt.

Fraction	Au	Pt	Pd
Magnetic, original	0.017	-0.002	-0.002
Magnetic, duplicate	0.030	-0.002	-0.002
Non-magnetic, original	11.90	0.059	0.014

representative of the entire prospect, it does appear as though a significant portion of the total gold budget in the gravels is tied up with pyrite, either as a component of the crystal lattice or as a minute native inclusion in pyrite aggregates.

Subsequent to the Bureau of Mines tests, a series of tests were conducted on box, wheel and spiral concentration devices using concentrates left after clean-up of the 500 yard test run. In this test, a one assay ton sample (29.166 grams) was concentrated by one of these three methods, then digested and fused to form a metallic bead. Table 2 shows the various methods employed and the results of each method.

TABLE 2

Fire Assay Results from Various Concentration Methods, Phelan Creek placer prospect. All values in opt.

Concentration Method	Gold Value
1. Box cons	0.36
2. Box cons, duplicate	0.29
3. Wheel cons	0.42
4. Wheel cons, duplicate	0.64
5. Wheel cons, duplicate	0.59
6. Wheel tails	0.52
7. Spiral Cons	6.14
8. Spiral tails	0.46
9. Spiral cons of Sample 7, crushed to -200 mesh	32.27

As these data indicate, some sort of spiral classification and concentration device is extremely effective at removing the fine gold normally left by a simple sluice box or wheel concentration device. Packing of riffles in a standard sluice box would cause loss of a large portion of the finer fraction of the concentrates. Similarly, recovery of fine gold by wheel concentration devices is sensitive to the efficiency of the classification stages prior to concentration. Poorly sorted grain size fractions would adversely affect recovery of fines in most wheel concentration devices.

Tin concentrations in Phelan Creek gravels have been identified only recently and as yet are poorly understood. Due to the lower specific gravity of cassiterite (6.8-7.1), the majority of any cassiterite in the bank run gravel probably would pass over the last riffle set in a standard sluice box. However, one sample of concentrate from the prospect was sent to the Alaska Division of Geological and Geophysical Surveys (Sample 47355) for analysis and returned a Sn value of 0.57% Sn. The analyses came from the magnetic fraction of the concentrate. Although cassiterite does have a relatively high magnetic susceptibility (90×10^6 emu) in comparison to some common minerals, it is considerably less magnetic than magnetite (5×10^{11} emu) or ilmenite (1.5×10^{11} emu). Thus it seems unlikely that tin values in the magnetic fraction are derived from cassiterite. Microscopic analyses did not detect visible cassiterite in the sample containing high tin in assay. However, microscopic analyses did indicate an abnormally high content of garnet in the concentrates. Since bedrock in this region is not metamorphosed on a regional scale to almandine facies, the garnets possibly are derived from lode Sn-W skarns or Cu-Au skarns where Cretaceous intrusives came into contact with calcareous rocks of the Tetelna Volcanics or Mankomen Group. Garnet skarns are also known from Nickolai Greenstone belt, particularly at the Nabesna Mine. Garnets are particularly good scavengers of tin from a silicate melt and could be the source of elevated tin values in magnetic fractions of Phelan Creek gravels. Since garnets do have elevated magnetic susceptibilities, they may have reported with the magnetic fraction. Cassiterite was detected in microscopic examinations by the U.S. Bureau of Mines and is probably concentrated in the non-magnetic fraction. By virtue of its specific gravity, the majority of the cassiterite present in Phelan Creek gravels probably washed through the normal sluice box set-ups utilized on the prospect.

Platinum groups of metals have been detected in two separate analyses of concentrates from Phelan Creek. A non-magnetic fraction (11% of total sample weight) examined by the Alaska Division of Geological and Geophysical Surveys (Sample 47356) yielded a value of 3.6 troy OPT Pt. In addition,

a sample of concentrate from the 500 yard test run was sent to the American Society for Applied Technology (Proj. #060284) for microscopic and assay analyses. The non-magnetic fraction produced four large (up to 935 microns) beads and several smaller beads from the 11 gram fraction. The beads exhibited an alligator-skin texture diagnostic of Platinum group metals in concentrations of 10Au:1PGE. The source for the PGE's at Phelan Creek probably is the numerous dismembered ultramafic bodies which have been tectonically emplaced along the Slate Creek fault. An ultramafic source is further supported by the ubiquitous presence of chromite in magnetic fractions from Phelan Creek.

RECOMMENDATIONS

Future work at the Phelan Creek prospect should be designed to determine the quantity of gold, tin and PGE's in typical bank run gravels. Determination of the quantity of free gold in the 500 yard test run should be attempted as well. Any grade-tonnage calculations would also require the total weight of heavy mineral concentrate left after clean-up of the 500 yard test run. Values obtained from the 500 yard test run would be conservative because of the rapid riffle packing observed and the loss of gold, PGE's and cassiterite which undoubtedly resulted. The following information is necessary in order to calculate meaningful grade-yardage information at Phelan Creek:

1. Total yardage through the box
2. Total free gold recovered
3. Total weight of heavy mineral concentrates recovered after gold is cleaned up
4. Assay heads for magnetic fractions of the heavy mineral concentrate
5. Assay heads for non-magnetic fractions of the heavy mineral concentrate

In addition to gravity separation methods, if gold and PGE levels in the average bank run gravels are as high as indicated from the few tests so far conducted, column tests for cyanidization recovery should be conducted by a reputable lab. Further testing is also needed to determine how much cassiterite is present in average gravels at Phelan Creek and whether inclusion of a tin cirquit would be cost effective in a commercial operation.

It is further recommended that continued bulk sampling and/or drilling be conducted in order to determine the potential mineable reserves at Phelan Creek. Present prospect management should consider an exploration lease-option on the property. Without such grade-yardage information, commercial operators will not commit major capital expenditures to the project.

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GEOLOGIC REPORT
PC85-3
C.J. Freeman
November 1985

GROSS METAL VALUE ESTIMATES FOR HEAVY MINERAL CONCENTRATES, PHELAN CREEK PLACER AU-SN-PGE PROSPECT, ALASKA

INTRODUCTION

In the summer of 1981 Mr. Daniel Jensen conducted bulk sampling activities on the Phelan Creek placer prospect near Isabel Pass, Alaska. The work consisted of a test run of 500 cubic yards of bank run gravel from claims owned by Mr. Joseph Taylor. The following report is an estimate of the gross metal value of heavy mineral concentrates based on the results the 500 yard test run. The total free gold recovered by Mr Jensen during the test is not known although negotiations currently are underway to obtain the results. The following estimates should be considered hypothetical and subject to revision when more reliable grade-yardage tests are conducted. Sources of error in these calculations are due to the small test run size, large reported loss of heavy minerals due to rapid sluice box loading and riffle packing, and the geochemical analysis method utilized on concentrate samples (fire assay). With these limitations in mind, the following report is submitted for consideration.

BACKGROUND DATA

The following is a list of control data used to determine the gross metal value of the heavy mineral fraction of the Phelan Creek gravels worked in the 500 yard test run :

- Number of Bank Yards Tested: 500
- Extraction Method: 1.625 cubic yard backhoe and sluice box
- Number of backhoe buckets per clean-up: 7-9 (Average = 8)
- Volume of concentrates per clean-up:1.25 50gallon drums = 0.3125 cubic yards per clean-up
- Average weight of gravel: 4500 lbs/yard = 2.25 tons/yard^3
- Average concentration ratio: 450 lbs conc./yard = 10:1

CALCULATIONS

The following calculations are predicated on assay values supplied by the U.S. Bureau of Mines and from operator information taken during the 500 yard test run.

1. Average volume of gravel run through the sluice box per clean-up = (8 bucketloads)(1.625 yards/bucket) = 13 cubic yards

2. Total Number of Clean-ups = (500 yards)/(13 yds/clean-up) = 38

3. Total Number of Drums of Concentrate = (38)(1.25 drums/clean-up) = 47.5 drums

4. Total Volume of concentrates = (47.5 drums)(0.25yds/drum) = 11.875 cubic yards

The results of the fire assay and microscopic analyses from the concentrates of the 500 yard test run are shown below.

TABLE 1
Phelan Creek Concentrate Analyses

Sample Number	Au Fire Assay Magnetic Fraction (oz/ton)	Au Fire Assay Non-magnetic Fraction (oz/ton)
AK-17777	0.023	11.90

Analyses by the Bureau of Mines indicated that the magnetic fraction of Sample Ak-17777 weighed 93.2 grams and consisted primarily of magnetite. The non-magnetic fraction of Sample AK-17777 weighed 14.6 grams and was composed primarily of pyrite. Thus the weight ratio of magnetic to non-magnetic fraction was 6.38:1. For purposes of this report, the magnetic fraction is assumed to be 100% magnetite (density = 5.18gm/cm^3) and the non-magnetic fraction is assumed to be 100% pyrite (density = 5.02 gm/cm^3). Since the densities of the two fraction components are essentially the same, the volume ratio for the two fractions will be taken as unity. Based on these assumptions, the following calculations are evident:

5. Magnetic Fraction Volume = (86.5%)(11.875 yds) = 10.27 cubic yds.

6. Non-Magnetic Fraction Volume = (13.5%)(11.875yds)=1.60 cubic yds.

A breakdown of magnetic versus non-magnetic gross metal ounces is as follows:

Magnetic Fraction

7. 10.27yds = (7,486,830cm^3)(5.18gm/cm^3) = 38,781,799 grams

8. (38.781799 x10^6)/(10^6 gm/metric tonne) = 38.78 tonnes mag conc.

9. (38.78 tonnes)(1.1 tons/tonne) = 42.66 short tons

10. Total contained gold= (0.023oz/ton)(42.66 tons) = 0.98 troy ounces of Au from the magnetic fraction of 500 yards of gravel.

Non-Magnetic Fraction

11. (1.60yds)=(1,166,400 cm^3)(5.02 gm/cm^3) = 5,855,328 grams

12. (5.855328 x 10^6)/(10^6 gm/metric tonne) = 5.85 metric tonnes non-magnetic concentrate.

13. (5.85 tonnes)(1.1 tons/tonne) = 6.43 short tons

14. Total Contained gold = (11.90 oz/ton)(6.43 tons) = 76.52 ounces gold from the non-magnetic fraction of 500 yards of gravel

To obtain the total gold contained in the magnetic and nonmagnetic fractions the following calculations are necessary:

15. Total Mag. + Non-Mag. Ounces = (0.98 oz) + (76.52 oz) = 77.50 oz. for every 500 cubic yards run through box.

16. Total ounces per yard = (77.50 oz)/(500 yds) = 0.155 oz Au/yd^3

17. Gross Gold Value (@$330/oz) = (0.155 oz/yd)($330/oz) =

$51.15 per cubic yard

CONCLUSIONS

Although these calculations are only rough estimates of the true conditions at the Phelan Creek prospect, the results reveal several important features of the prospect which are of economic significance to potential operators. Perhaps the most significant point is the fact that over 98% of the contained metal value is derived from the non-magnetic fraction of the gravel concentrates. This non-magnetic fraction constitutes only 13.5 wt.% and 13.5vol.% of the total heavy mineral concentrate. Thus removal and discard of the magnetic fraction of the concentrates would result in the loss of only 1.3% of the total contained metal value in gold. Equally important is the extremely high gold values indicated in the non-magnetic fraction, probably tied up with the pyrite portion of the concentrate. Assuming the non-magnetic fraction is composed of 100% pyrite, the 6.43 tons of non-magnetic fraction recovered from 500 yards of gravels converts to over 25 pounds of pyrite concentrate per cubic yard of gravel mined. A moderate size operation of 2000 yards per day through the box would recover approximately 50,000 lbs or 25 tons of pyrite concentrate per day containing (11.90 oz/ton)(25 tons) or 297.5 troy ounces of gold worth $98,175 (at $330/oz Au). Values this high from concentrates from which the free gold fraction has already been removed certainly deserve further investigation. If similar values can be determined to exist over a reasonably large area of the claims, it is conceivable that a magnetic separation circuit followed by a CN curcuit or direct smelter shipment arrangement could be justified. It is recommended that a more rigorous and thorough sampling program be conducted from which statistically valid conclusions can be drawn. If results are similar to the above calculations and conclusions, the Phelan Creek prospect could prove to be a highly profitable mining venture.

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Geologic Report
PC 85-2
C. J. Freeman
November 1985

GRADE-YARDAGE ESTIMATE AT THE PHELAN CREEK PLACER AU-SN-PGE PROSPECT, ALASKA

INTRODUCTION

The following grade-yardage estimates are derived from the results of ten bulk samples collected from the Phelan Creek prospect by Mr. Joseph Taylor in late 1979. At present, these ten samples are the only documentable bank run gravel assay analyses available for the prospect. Although rigorous statistical treatment of such a small sample population is not definitive, the following calculations are sufficiently attractive to warrant further extensive investigations. If similar grade-yardage results can be documented over a large enough area of the claim block, the Phelan Creek prospect would represent a highly attractive mining venture for a medium to large operator. With the statistical and analytical uncertainties known, this report is presented for consideration. References to geological and geochemical information are found in Geologic Report PC 85-1 (Freeman, 1985).

RAW SAMPLE DATA

Table 1 is a compilation of data concerning the ten grab samples from the Phelan Creek prospect that will be considered here. Sample numbers are assigned in this report for ease of reference.

Average adjusted gross metal value for the below samples is $4.11 per ton at a grade of 0.028 oz/ton. All samples in Table 1 were collected from depths of less than one foot except sample number PC79-12 which was collected from a depth of six feet. Samples were taken over a wide area on the claims.

GRADE-YARDAGE CALCULATIONS

The adjusted gross metal value given below must be converted to dollars per bank run cubic yards of gravel before economic criteria and cost comparisons can be considered. The conversion factor used in this report was determined from a

TABLE 1

Grab Samples from the Phelan Creek Prospect

Sample Number	Total Weight (grams)	% Fines (assay)	% Coarse (reject)	Au Values (fire assay) oz/ton	Gross Value Per Ton @ $330/oz
PC79-1	8202	74	26	0.03	$ 7.32
PC79-2	3787	56	44	0.04	7.39
PC79-3	5117	38	62	0.01	1.25
PC79-4	2973	64	36	0.03	6.33
PC79-5	3139	30	70	0.04	3.96
PC79-6	5289	30	70	Trace	0.00
PC79-7	6511	06	94	0.02	0.39
PC79-8	6512	06	94	0.03	0.59
PC79-10	3055	66	34	0.06	13.07
PC79-11	2823	13	87	0.02	0.86

500 cubic yard test run completed by Mr. Dan Jensen in 1981. Using this conversion factor (2.25 tons/yd^3) the ten samples from Phelan Creek yield an average of $9.25 per cubic yard of bank run gravel. No values have been assigned to tin or platinum group elements in the gravels since no reliable assay data are available for these commodities. The added value of the Sn and PGE concentrates will help offset some of the uncertainties introduced by the small sample number and the maximum assay values obtained from fire assays.

Given the favorable physical conditions present on the claims, namely zero feet of overburden, essentially zero vegetation and extremely large areas of workable gravels, an estimate of the total contained ounces of gold can be obtained. A conservative estimate of the mining parameters is as follows:

1. Est. Average pay zone thickness: 5 yards
2. Est. Average pay zone length/claim: 440 yards
3. Est. Average pay zone width/claim: 220 yards (actual claim is 440 yards wide)
4. Est. Total mineable yards/claim: 484,000 cubic yards

Using these estimates, the total gross metal value per claim (@ $330/oz Au) equals $4,477,000. Thus the gross metal value for the entire 21 claim block held by Mr. Taylor could reach $94,017,000. Using the above grade estimates, the Phelan Creek prospect could contain up to 13,552 troy ounces Au per claim or 284,592 troy ounces Au for the entire claim block.

CONCLUSIONS

Despite the statistical and assay uncertainties discussed above, the $9.25 per cubic yard value indicated in this report is sufficiently attractive to warrant further work on the prospect. The location, ease of access and extremely favorable physical conditions which exist at Phelan Creek further enhance the attractiveness of the prospect. Given that the average break-even price for central Alaskan placer operations is in the neighborhood of $4.50 per cubic yard, if the Phelan Creek prospect can be shown to contain values similar to those outlined above, the resulting rate of return on investment should exceed 20%.

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