Placer gold and associated heavy minerals of the Clear Creek drainage, central Yukon: Past to present

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ABSTRACT

Placer gold mining in Clear Creek extends back to 1900, when the discovery claim was staked. Approximately 129,000 crude ounces (4012 kg) of gold have been reported since 1941 which includes 49,637 crude ounces (1544 kg) obtained by dredging operations (1941 to 1955, and 1981 to 1987). Placer gold morphology ranges from crystalline gold in quartz to rounded nuggets to flattened gold. The largest nugget, recovered from the headwaters of Left Clear Creek, weighed 7 ounces (218 g).

Clear Creek valley was filled by ice during the pre-Reid glaciation (early Pleistocene). Pre-Reid glacial drift is preserved as till, resedimented till, and glaciofluvial sediments on the lower slopes along main Clear Creek and parts of Left Clear Creek. Alpine glaciers formed at the headwaters of Left Clear Creek, however most of the moraine deposits have been eroded. During the subsequent Reid and McConnell glacial periods local alpine glaciers formed in the headwaters of Josephine and Big creeks. Alpine glaciers, the pre-Reid ice sheet and their melt waters redistributed the gold in the Clear Creek drainage.

The distribution of heavy minerals in Clear Creek drainage is varied. Over the years dredging operations intersected pockets of gravel containing cassiterite, scheelite and galena, but their precise locations were not documented. Contemporary placer mining and our heavy mineral studies have located concentrations of pyrite, arsenopyrite, scheelite and galena, in addition to gold. Exploration for the source of placer gold has resulted in the discovery of numerous gold veins in the surrounding area.

RÉSUMÉ

L'exploitation de placers aurifères au ruisseau Clear remonte aux années 1900 alors que fut jalonné le claim de la découverte. On a signalé depuis 1941 l'extraction d'environ 129 000 onces d'or brut (4012 kg), ce qui inclut 49 637 onces d'or brut récupérés par dragage (de 1941 à 1955 et de 1981 à 1987). L'or placérien récupéré au ruisseau Clear présente une morphologie variant de l'or cristallin dans le quartz à des pépites d'or aplaties à arrondies. La plus grosse pépite pesait 7 onces (218 g) et fut récupérée sur le cours supérieur du ruisseau Left Clear.

La vallée du ruisseau Clear a été comblée par la glace durant la glaciation de pré-Reid (Pléistocène inférieur). Les dépôts glaciaires pré-Reid sont conservés sous forme de till, de till redéposé et de sédiments fluvioglaciaires sur le bas des pentes le long du ruisseau Clear principal ainsi que sur des parties du ruisseau Left Clear. Des glaciers alpins se sont formés sur le cours supérieur du ruisseau Left Clear, mais la plupart des dépôts morainiques ont été érodés. Pendant les périodes glaciaires ultérieures de Reid et de McConnell, des glaciers alpins locaux se sont formés sur le cours supérieur des ruisseaux Josephine et Big. Les glaciers alpins, la nappe glaciaire pré-Reid et leurs eaux de fonte ont redistribué l'or dans le bassin versant du ruisseau Clear.

La répartition des minéraux lourds dans le bassin versant du ruisseau Clear est variable. Au fil des ans, les travaux de dragage ont recoupé des poches de gravier contenant de la cassitérite, de la scheelite et de la galène, mais les positions précises de ces amas n'ont pas été relevées. Les travaux contemporains d'exploitation de placers aurifères et nos études des minéraux lourds ont permis de localiser des concentrations de pyrite, d'arsénopyrite, de scheelite et de galène en plus de l'or. L'exploration visant la recherche de(s) la source(s) de l'or placérien a permis la découverte de nombreux filons aurifères dans les environs.

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INTRODUCTION

Placer gold has been mined from the Clear Creek drainage episodically since 1900. The history of placer mining in the Clear Creek drainage, as well as the total gold production, is poorly documented. We present a compilation of the historical development of placer mining in the Clear Creek drainage and present data that document the recovery of more than 129,000 crude ounces (4012 kg) of placer gold.

The origin of gold-bearing gravel deposits is poorly understood. We compiled the glacial and depositional history of the region and present new sedimentological sections and data that indicates a largely fluvial origin for gold-bearing gravel in the valley of the Clear Creek drainage, overlain by organic-rich silt and sand ("muck").

The hard rock source(s) of placer gold have intrigued explorationists for decades. Although some lode gold occurrences have been recognized in the region, they are typically low-grade or the gold grains are very small. This is in sharp contrast to coarse placer nuggets weighing up to 7 oz (218 g) that have been recovered from creek gravels. The goal of this study is to better constrain potential lode sources of the placer gold in the Clear Creek area by examining the characteristics of the gold (including fineness[1]) and the associated heavy mineral suite. A total of 29 samples of panned heavy minerals were collected from many of the tributaries to Clear Creek (Fig. 1).

PREVIOUS WORK

Previous studies of the surficial geology in the Clear Creek drainage were carried out by Bostock (1966) and Hughes et al. (1969), who both noted that Clear Creek is beyond the Reid and McConnell glacial limits of the Cordilleran ice sheet. More recently, Morison (1983a; 1984) undertook a sedimentological study of the Clear Creek surface deposits. Even more recently,

[1]Fineness, expressed in parts per thousand, is defined as the ratio of gold to gold plus silver, multiplied by 1000 (Au/(Au+Ag)x1000) (Boyle, 1979).

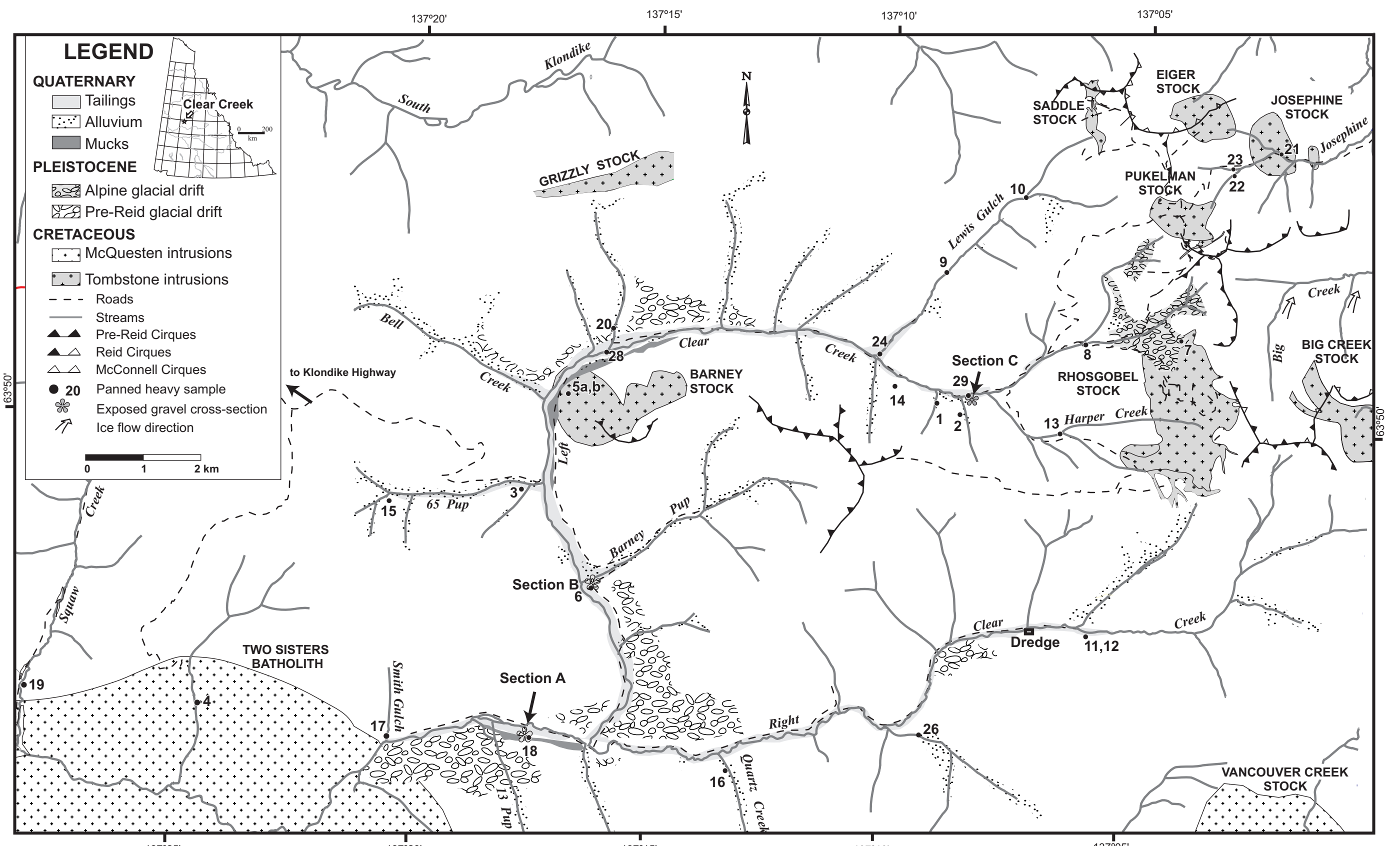

Figure 1. Compilation of major surficial and bedrock geological features and locations of panned heavy samples from Clear Creek drainage. Geology modified from Murphy et al. (1996) and various assessment reports. Areas defining alluvium, alpine and pre-Reid glacial drift from (Morison, 1983b). The location and approximate age of cirques (alpine glaciers) illustrated on this map were interpreted from air photos for this study to determine the effects of local glaciation.

Bond and Duk-Rodkin (in progress) conducted surficial mapping (1:250 000 scale) of the McQuesten region, including indications of meltwater flow in the Clear Creek drainage.

Regional bedrock geological maps (1:250 000 scale) of the area have been produced by Bostock (1964), but the region benefits from recent detailed geological mapping (1: 50 000 scale) (Murphy et al., 1996) and an accompanying summary report (Murphy, 1997). Hard rock exploration in the Clear Creek region has been documented since 1902 (Yukon Minfile), but has been particularly active for over the last 20 years, including Bema Resources Ltd. from 1979 to 1982, Gold Rite Mining Co. from 1987 to 1988, Ivanhoe Goldfields Ltd. in 1994, and Kennecott from 1995 to 1996. Detailed descriptions of veins and skarns (Rhosgobel, Josephine, Lewis, and Pukelman), that occur at the headwaters of Clear Creek (Fig. 2), and their associated mineralization were presented by Emond (1986, 1989) and Emond and Lynch (1990).

PREVIOUS MINING ACTIVITY

Since 1900, the Clear Creek drainage has had a long and varied history of placer mining including hand workings, hydraulicking, draglines, two periods of dredging, and contemporary heavy machinery. Mining has been sporadically active at various locations

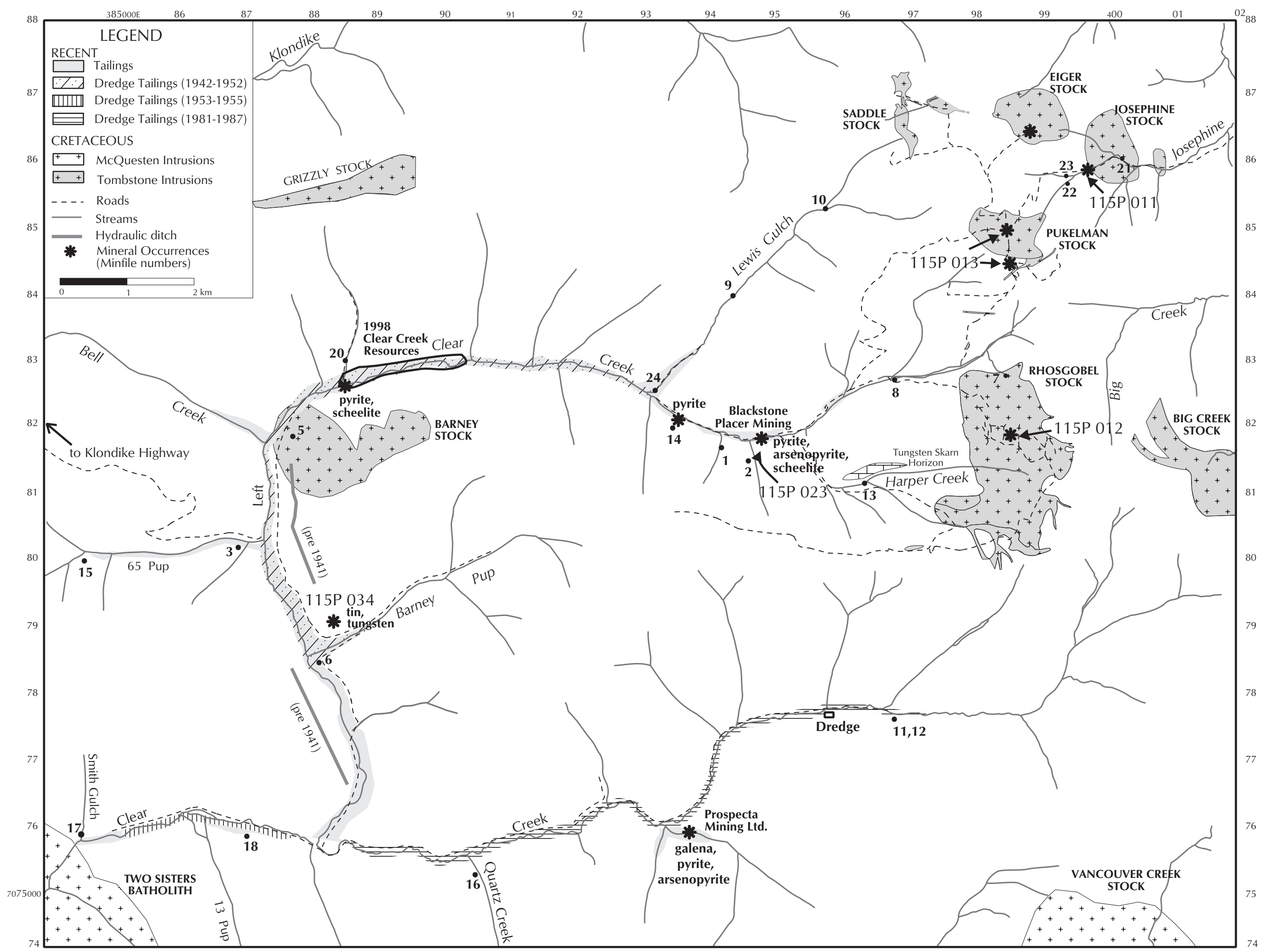

__Figure 2.__ Location map showing regions mined with the bucket-line dredge, as well as known and suspected heavy mineral occurrences. Suspected occurrences are based on local abundances of heavy minerals found associated with placer gold in sluice boxes. Note galena is reported in quartz veins near the Vancouver Creek stock. Geology modified from Murphy et al. (1996) and various assessment reports. See Yukon Minfile or Murphy (1997) for detailed descriptions and mineral occurrences.

along Clear Creek including the lower reaches of the main drainage (near Barlow Creek), as well as the left and right forks.

The earliest documentation of mine workings was by Bostock, who, during a field visit in 1947, described a large overshot wooden wheel and a three inch (7.6 cm) wooden hydraulic monitor about 4 ft (1.22 m) long, fitted onto another piece of wooden pipe by a wooden ball and socket joint (Bostock, 1990). This apparatus was likely used in the 1910s or 1920s. Information on the history of hydraulicking on Clear Creek is sparse, with only mention of ditches dug opposite Barney Pup for hydraulicking purposes (Bostock, 1990).

In 1939, the first steel sluice boxes to be used in the Yukon were set up on the left fork of Clear Creek. These steel sluice boxes, 40 in (1.02 m) wide and 60 ft (18.3 m) long, were set into bedrock. The gravel was moved to the boxes by hydraulicking and a tractor with a dozer plough. The $1^1/_2$ cubic yard (1.15 m^3) diesel drag-line scraper was to be stationed at the lower end of the boxes to stack the tailings with an expected capacity of 1500 cubic yards (1146 m^3) per day (Bostock, 1941).

DREDGING

Historical dredging operations are the best documented and perhaps the most interesting mining activity on Clear Creek. A dredge processed the largest volume of gravel of any operations within the drainage. A bucket-line dredge operated on Clear Creek from 1942 to 1952 (left fork), 1953 to 1955 (confluence of left and right forks), and 1981 to 1987 (right fork), processing more gravel than all other mining methods.

The first prospecting for dredging was completed in 1939 on the left fork of Clear Creek by sinking steel caissons to bedrock and keeping the hole dry with a gasoline-driven Rex pump. All gravel from the hole was sluiced by discharge water from the pump (Bostock, 1941). Clear Creek Placers Ltd. (formerly Canadian Placers Ltd.) originally operated on the left fork of Clear Creek using drag-line equipment. In 1942, they discontinued their drag-line operations and constructed a pontoon-type steel-constructed dredge that operated on the left fork from 1942 to 1952, consecutively (Debicki, 1983a). Each season, bulldozers stripped approximately one mile (1.6 km) ahead of the dredge to thaw the ground for the following season, although the seasonal progress of the dredge was less than one mile. From 1942 to 1952, the dredge worked $4^1/_2$ miles (~7.2 km) of Left Clear Creek starting below Barney Pup (Bostock, 1990). The dredge worked its way upstream to the confluence of Lewis Gulch where it discontinued operations (Fig. 2) after concluding that all economic placers had been mined from this fork (Debicki, 1983a).

The dredge was moved at the end of the 1952 season and continued operations from 1953 to 1955, mining $1^1/_2$ miles (~2.4 km) of Clear Creek downstream from its confluence with Left Clear Creek (Fig. 2). Dredge operations were terminated in 1956 due to rising costs and fixed gold prices (Debicki, 1983a). The dredge was eventually dry-docked at the confluence. During its operation in the 1940s and 1950s the dredge processed an average of 230,000 cubic yards (175,720 m^3) of gravel annually at a grade of 41¢/cubic yard (Table 1).

In 1979, Queenstake Resources Ltd. undertook an aggressive placer exploration program and became interested in the placer potential of Clear Creek, performing a backhoe sampling program on the first 7 miles (11.2 km) of Right Clear Creek, and deemed it suitable for a dredging operation. Exploration work and bulk sampling indicated an average grade in the order of $8.00 to $10.00 per cubic yard with gold at $500 an ounce. This sampling program estimated reserves be in excess of 3 million cubic yards (2,292,000 m^3) of gravel, averaging 12 ft (3.66 m) in depth with an average mining width of 200 ft (61 m) (Queenstake Resources Ltd., 1980). In 1980, Queenstake Resources Ltd. acquired the old dredge on Clear Creek and following 16 years in “drydock,” the dredge was christened “John W. Hoggan – Queenstake #1.” Mr. Hoggan was the dredge superintendent during the mining of the left fork of Clear Creek from 1952 to 1956 and his brother, Greg Hoggan, was a member of the small team that carried out the renovation of the dredge (Queenstake Resources Ltd., 1981).

After over a million dollars worth of renovations and ground preparation, the dredge was back into operation on the right fork of Clear Creek in 1981. Renovations included upgrading the power plant from its original Vivian diesel generator 250 h.p. to a Caterpillar #3406 PCTA diesel-powered generator 265 Kw 275 h.p. Pumps used on the dredge included a high pressure pump for trommel spray pipe mounted in hull (3500 g.p.m. with a 50 foot (15.2 m) head) and a low pressure pump that delivered water to the head of the distributor sluices (1600 g.p.m. with 25 foot (7.6 m) head; Queenstake Resources Ltd., 1979).

For mining, the dredge was anchored to buried deadmen by starboard bow and stern cable lines, and port bow and port stern cable lines. The dredge pivoted on the spud and the digging bucket line moved in an arc of approximately 100 ft (30.48 m) by the bow lines. The dredge was capable of mining approximately 18 ft (5.5 m) ahead before lifting the spud and moving across the pond to start the next face. The maximum digging depth of the dredge was 20 ft (6 m) below water level, including 2 to 5 ft (0.6 to 1.5 m) of the underlying decomposed and fractured bedrock where gold was concentrated (Queenstake Resources Ltd., 1981). In one day the dredge could move a 200 foot (60.6 m) wide by 12 foot (3.6 m) deep mining face ahead by 20 to 40 ft (6 to 12 m). Ground was stripped in advance of the dredge by bulldozers.

The dredge, comprising seventy $3^1/_2$ cubic ft (1.15 m^3) buckets, could mine 85 to 150 cubic yards (65 to 114.5 m^3) per hour.

Table 1. *Annual recorded production for the Clear Creek drainage. Note: Fine ounces of gold represent gold that has been refined (removal of impurities).*

Production by Clear Creek Placers Ltd. (formerly Canadian Placers Ltd.) dredging operations

Year	Fine ounces gold	Production (cubic yards)	Other reported values (Dollar values below represent value of gold at that time)	Reference
1941	~2,289*	119,600	$77,470.60	Debicki, 1983a
1942	949.2	57,400	$27,861.68 (48.05¢/cubic yard)	Debicki, 1983a
1943	3 ,564.75	244,860	$137,242.95 ($38.5¢/oz)	Debicki, 1983a
1944	~5,492.6*		$190,000	Debicki, 1983a
1945			No information available	
1946	2,706.56	303,040		Debicki, 1983a
1947	2 491	318,000		Debicki, 1983a
1948	2,489.05	317,000	27.5¢/cubic yard (gold at $35/oz)	Debicki, 1983a
1949	3,301.96	239,400	812 fine oz silver	Debicki, 1983a
1950	4,715.84	419,700	1 205 fine oz silver 0.011 fine oz/cubic yard	Debicki, 1983a
1951	2,293.48		$85,516.89	Debicki, 1983a
1952	749.30	120,000	$25,517	Debicki, 1983a
1953	2,692.68	248,800	$93,466 (37.5¢/cubic yard) 0.012 crude oz/cubic yard	Debicki, 1983a
1954	2,368.94	202,000	$83,200 (40.5¢/cubic yard) 0.014 crude oz/cubic yard	Debicki, 1983a
1955	1,417.40	143,000	$49,120 (34.35¢/cubic yard) 0.012 crude oz/cubic yard	Debicki, 1983a
Total	**37,522**	**2,589,800**		

Production by several various operators on Clear Creek

Year	Crude ounce gold	Other	Reference
1956	289.49*	Fine oz	Debicki, 1983a
1957	376.84*	Fine oz	Debicki, 1983a
1958	217.35*	Fine oz	Debicki, 1983a
1961	300		Skinner, 1962; Green & Godwin, 1964
1962	689		Green & Godwin, 1963; 1964
1963	670	658 oz from 40,000 cubic yards 12 oz from 27,000 cubic yards	Green & Godwin, 1964
1964	950	70,000 cubic yards mined. Fine gold and fine-grained specularite (hematite) and magnetite in heavies	Green, 1965
1973	150		Sinclair & Gilbert, 1975
1978	385		Gilbert, 1986
1979	620		Gilbert, 1986
1980	938		Gilbert, 1986
1981	2,400		Gilbert, 1986
1982	2,689		Gilbert, 1986
1983	6,972		Gilbert, 1986
1984	2,991		Gilbert, 1986
1985	3,680		Placer Mining Section, 1996
1986	3,646		Placer Mining Section, 1996
1987	4,834		Placer Mining Section, 1996
1988	4,290		Placer Mining Section, 1996
1989	6,725		Placer Mining Section, 1996
1990	9,372		Placer Mining Section, 1996
1991	6,930		Placer Mining Section, 1996
1992	3,227		Placer Mining Section, 1996
1993	2,536		Placer Mining Section, 1996
1994	3,005		Placer Mining Section, 1996
1995	3,522		Mining Inspection Division, 1998
1996	2,292		Mining Inspection Division, 1998
1997	1,607		Mining Inspection Division, 1998
Total reported gold recovered from 1956-1997: 75,420 crude oz + 884 fine oz			

*oz calculated based on reported dollar value

The dredge was designed to process up to 350,000 cubic yards (267 400 m^3) per year depending on the length of the operating season and the depth of the gravel. For 1981, the dredge was expected to mine between 250,000 and 300,000 cubic yards (191,000 to 229,299 m^3) with a net operating profit of approximately $1.5 million (Queenstake Resources Ltd., 1980). Despite the capacity of the dredge, it only mined an average 200,000 cubic yards per year during the 1980s (Table 2).

The dredge operated seasonally full-time from 1981 to 1987. Reserves calculated at the property were based on a sampling program with 162 backhoe pits and a drilling program of 25 rotary drill holes carried out between 1979 and 1984. Remaining reserves, calculated in 1985, totalled 900,000 cubic yards of gravel at 0.011 ounces of gold per cubic yard (Gutrath, 1986). In 1987 the dredge terminated mining activities on Clear Creek due to low gold prices (INAC, 1988). Annual production reported for the dredge averaged 200,000 cubic yards (152,800 m^3) per year at a grade of $3.93/cubic yard, indicating that reserves remain. The dredge is presently situated where it discontinued operations on the right fork of Clear Creek (Fig. 2). Mining has not been attempted upstream from this locality.

Queenstake Resources Ltd., also conducted a program of drilling, seismic, and backhoe pit sampling program on Big Creek (Fig. 1; Queenstake Resources Ltd., 1980; 1981). The results, reserves in the order of 7 million cubic yards (10.5 million tons) of gold bearing gravel, suggested that although it is not a viable dredge prospect, the property, depending on metal prices and further testing, could support a bulldozer/sluice operation.

MINING TODAY

Mining continues today on the main drainage of Clear Creek as well as the right and left forks in regions where the dredge was unable to mine, such as the smaller tributaries, neighbouring alluvial benches, and beyond the dredge limits. Streaks of pay dirt were left behind along the shallow sides of the creek, in deep pockets, and up the tributaries. In 1998, only three operations were active on the right and left forks due to low gold prices (~$290/oz).

PRODUCTION HISTORY

We documented the recovery of 75,420 crude ounces (2346 kg) and 38,366 fine ounces (1193 kg) of placer gold from the Clear Creek drainage from 1941 to 1997 (Table 1). Data are from several sources including Queenstake Resources annual reports, placer mining industry reports published by DIAND, and GSC papers. Production data were not available for the years 1945, 1959, 1960, 1965-1972, 1974-1977. A calculation of total gold recovery for Clear Creek, based on annual averages for the years in which data is not available, as well as a conversion of fine to crude gold (based on 800 fineness) suggests that actual recoveries were over 129,000 crude ounces (4012 kg). The years with the greatest production correspond with the years that the dredge operated (1941-1955 and 1981-1987) and also from 1989 to 1991, which corresponds to years of high gold values (Fig. 3). Between the years 1989 and 1991 there were up to eleven operations active on Clear Creek. Since then the number of active operations on Clear Creek has dropped to four or five with the decreased value of gold.

It should be noted that production figures reported for placer gold in the Yukon are accepted as minimum values. Available data are derived only from placer gold sold outside the Territory. As a result, much of it goes unreported.

Table 2. *Annual production figures for Queenstake Resources Ltd. (data for 1985 is unavailable).*

Year	Crude ounces	Fine oz	Fineness	Production (cubic yards)	Grade (fine oz/cubic yard)	Operating Costs	Reference	Location
1981	1685			2000/day			Queenstake, 1981	63°47' 137°15'
1982	2020	1619	801	184,450	0.0088	$789,605	Gutrath, 1986	
1983	5252	4232	806	215,600	0.0196	$696,619	Gutrath, 1986	63°47' 137°13'
1984	2023	1586	784	193,880	0.0082	$744,345	Gutrath, 1986	
1985								
1986	1136	909*						
1987	849*	679		191,415	0.004		INAC, 1988	
Total	**15,000****	**9025***	**Average = 800**	**Average = 196,300**	**Average = 0.0101**			

*Gold figures estimated based on an average fineness of 800.
**Total value estimated using an average value for 1985 based on other reported figures

GLACIAL HISTORY

The McQuesten River drainage basin, including the Clear Creek region, was affected by the pre-Reid (early Pleistocene), Reid (middle Pleistocene), and McConnell (late Pleistocene) glacial periods. The pre-Reid glacial period, the most extensive glaciation in the Yukon with multiple stages, was the only event that directly affected the valleys of Clear Creek (Fig. 2). Pre-Reid glacial deposits include till, resedimented till, and glaciofluvial sediments on the lower slopes of the valley sides. Pre-glacial fluvial gravels deposited by multi-channelled river systems are preserved under 2 m of pre-Reid diamicton characterized by a clayey silt matrix with subrounded to rounded clasts, thought to represent a melt-out till (Morison, 1984). A series of resedimented melt-out till units, up to 5.5 m thick, overlie the diamicton. These deposits are massive with subangular to subrounded clasts within a silty sand to fine sand matrix separated by 10 cm thick beds of fine sand to grey clay (Morison, 1984). The pre-Reid fluvial system, as noted at the mouth of Left Clear Creek, was multi-channelled and auriferous (Morison, 1984). Alpine glaciers also formed during the pre-Reid glacial period in the headwaters of Left Clear Creek, however, most of the sediment from this glaciation has been eroded from the valley sides (Fig. 2).

Clear Creek is beyond both the Reid and McConnell glacial limits of the Cordilleran ice sheet (Bostock, 1966; Hughes et al., 1969). Local alpine glaciers formed during the Reid or McConnell glacial periods (Morison, 1984) in the neighbouring Josephine and Big creeks (Fig. 2). The northwest portion of Vancouver Creek and the divide over to the right fork of Clear Creek demonstrates a large U-shaped valley, suggesting previous glacial activity up southern tributaries of Clear Creek. As a result of the McConnell glaciation, fluvial systems eroded and downcut through thick pre-existing glacial deposits resulting in the formation of creek and gulch placer deposits.

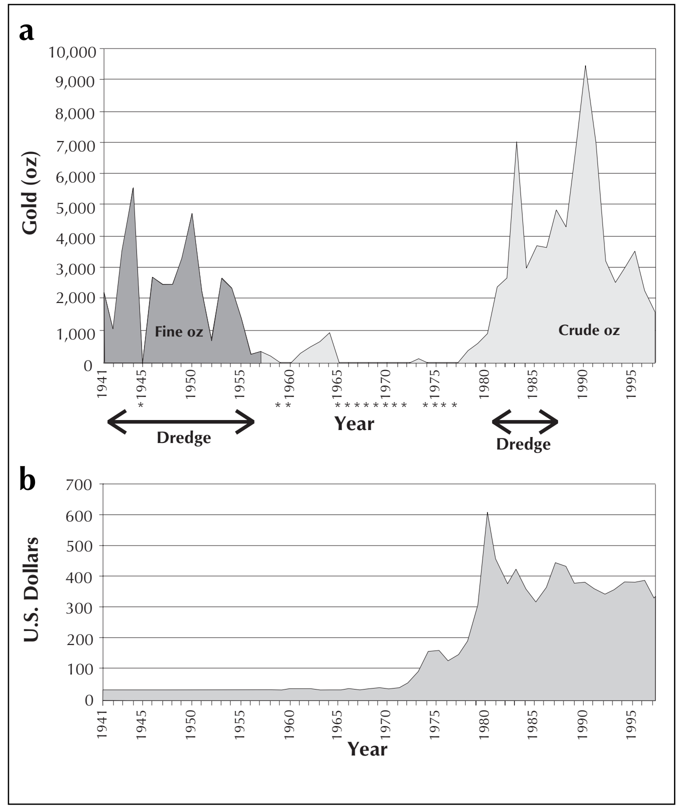

Figure 3. ***a)*** *Reported gold production figures for Clear Creek from 1941 to 1997. Data are from several sources including Queenstake Resources annual reports and placer mining industry reports published by DIAND. Production data were not available for the years 1945, 1959, 1960,1965-1972,1974-1977 (marked by *). Total documented production is greater than 120,000 crude ounces.* ***b)*** *Annual average gold prices from 1941 to 1997.*

SURFICIAL GEOLOGY

Three gravel sections, exposed in mining cuts along the Clear Creek drainage, were measured and described in detail during the 1998 field season to determine the sedimentological character of the gravel deposits within the creeks (Fig. 4). These sections were measured at the mouth of Barney Pup (B), Harper's property (C), and a section approximately 1 km downstream from the confluence of the left and right forks of Clear Creek (A; Figs. 1 and 4). Each section displays a slightly different succession of gravels and associated sediments. No other sections were sufficiently exposed during this study due to depressed mining activity.

Surficial deposits noted in these sections include gravel, organic-rich silt and sand ("muck"); organic-poor sand, and diamicton. The most profitable placer deposits are in creek gravels underlying organic-rich silt and sand, most notably on Clear Creek. These gravels are unconsolidated, clast-supported, and contain well-rounded to subangular clasts ranging from pebble- to boulder-size. The matrix generally consists of a mixture of sand, silt, and granules. Clasts were derived from local rock types occurring within the drainage, including schist, quartzite, as well as rocks from nearby intrusions and dykes including granites, diorites, and lamprophyres. Gold is generally reported from the basal fluvial gravels directly overlying bedrock within the valley bottoms and adjacent benches of the Clear Creek drainage.

Lenses of muck, up to 7 m thick, are noted on Clear Creek near its confluence with Left Clear Creek. A few vertebrate fossils have been found within the muck deposits by local placer miners (Dean Klassen, pers. comm., 1998). The mucks on Clear Creek overlie auriferous fluvially washed gravel (Fig. 4). Other surficial deposits within the drainage include colluvial veneers and blankets, debris and sediment flow deposits, and alluvial fans, terraces, and plains (Morison, 1983a and b). Morison

(1983a) reported a radiocarbon date of 6230 ± 80 years from unknown material, perhaps wood, in valley bottom gravels from an unlocated section along the Clear Creek drainage, suggesting recent fluvial deposition.

Within the valley bottom, unmined gravels appear to be of fluvial origin, suggesting that they were not deposited directly by glaciers. The gravels may have been deposited by melt waters derived from local alpine glaciers, present during the pre-Reid glacial period, eroding and transporting gold from sources further upstream. Morison (1983a; 1984) interpreted these fluvial sediments as braided stream successions formed in an environment of high, fluctuating discharge levels.

BEDROCK GEOLOGY

The predominant bedrock in the upper reaches of Clear Creek include variably calcareous phyllite, schist and psammite of the Upper Proterozoic to Lower Cambrian Yusezyu Formation, Hyland Group (Murphy et al., 1996). The region is also underlain by several plutons belonging to two Cretaceous plutonic suites (Fig. 1). Members of the dominantly granite, ~64 Ma McQuesten plutonic suite outcrop in the southern portion of the study area and include the Two Sisters batholith and the Vancouver Creek stock. The ~91 Ma Tombstone plutonic suite include diorite to granite that outcrop at the headwaters of Left Clear Creek (Saddle, Eiger, Josephine, Pukelman, Rhosgobel, Josephine and Big Creek stocks), and the Grizzly and Barney stocks, in the western portion of the region.

MINERALIZATION

Numerous hardrock mineral occurrences have been discovered near the headwaters of Clear Creek, and undoubtedly influence the nature of the heavy mineral populations of creek gravel. The varied nature of mineralization within the drainage includes: intrusive-hosted, sheeted low-sulphide gold-scheelite quartz veins, arsenopyrite-rich quartz veins, auriferous disseminated and replacement-style sulphide mineralization, and tungsten skarns. Occurrences are well described in other reports (Emond and Lynch, 1990; Murphy et al., 1993; Murphy, 1997; Marsh et al., 1999) and occur within or adjacent to the six stocks at the headwaters of Clear Creek. Gold mineralization is

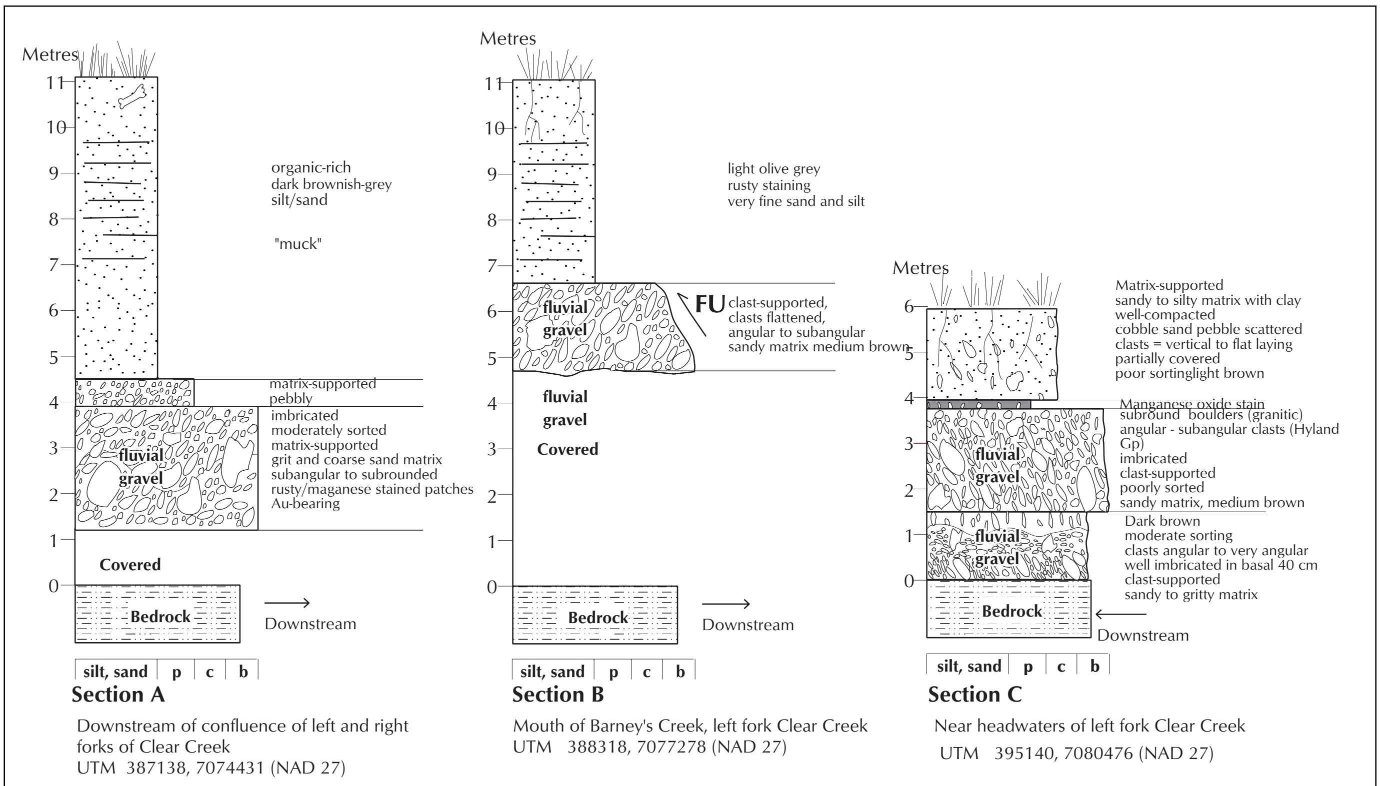

***Figure 4**. Three sedimentological sections from the Clear Creek drainage illustrating the variation in sediment assemblages. The gravels characteristically show good imbrication consistent with the present day flow direction of the creek. Lithologies of clasts within the gravel reflect local bedrock, consisting of schistose, quartzite, and intrusive rocks. Gold is typically retrieved from gravels directly overlying bedrock. Underlying bedrock in each of these sections is Hyland Group schist and quartzite. Refer to Figure 1 for the location of these sections. FU = fining upward, p = pebble, c = cobble, and b = boulder.*

largely characterized by an association with scheelite and arsenopyrite. Cassiterite, galena and tourmaline are also characteristic of mineral occurrences in the region.

Extreme enrichment of various heavy minerals, periodically revealed by placer miners, likely indicates proximity to mineral lodes. Hundreds of pounds of cassiterite were recovered per shift from gravel dredged for gold approximately 2 km upstream from Barney Pup during the 1940s (Bostock, 1990; Kreft, 1993). Downstream from Lewis Gulch the dredge hit a galena vein, although the position of the vein was never accurately located (Nels Harper, pers. comm., 1998). Dredging operations also intersected pockets of scheelite, although their precise locations were not documented. Recent placer mining, and our heavy mineral studies have revealed the presence and location of local concentrations of pyrite, arsenopyrite, scheelite, and galena, in addition to gold (Fig. 2). Massive pyrite bands up to 1 m thick were encountered by Blackstone Placer Mining through placer operations on Left Clear Creek in 1987 (Yukon Minfile). Placer mining operations on Right Clear Creek by Prospecta Mining Ltd. recovered large amounts of galena in their sluice box in 1998.

HEAVY MINERAL CONCENTRATE ANALYSIS

The evaluation of heavy mineral populations in placer gold environments has proven useful in determining mineralized hardrock sources (Gleeson, 1970; Boyle and Gleeson, 1971). We collected 29 panned samples from various localities along the left and right forks of Clear Creek for heavy mineral analysis to determine the relationship between bedrock at the headwaters and gravels deposited on the valley bottoms. Where possible, samples were collected from unmined gravel along the creek bed, on or near bedrock. In regions where extensive mining is active or has occurred in the past, samples were taken from washed or reworked gravel. The samples were panned in the field and dried for further separation. Four samples (98TLA25, 26 28, and 29) were concentrated in the sluice box where retrieved from placer operations and examined as is. The magnetic and other portions may have been removed from the sluicebox samples.

In the laboratory, the samples were further concentrated using the heavy liquid sodium polytungstate. Minerals and rock fragments with a specific gravity of greater than 2.889 sink to the bottom, while less dense fragments float to the surface and are removed. Although quick and toxic-free, the method does not produce a completely clean heavy mineral concentrate. Identification of the heavy minerals was performed using a binocular microscope, an ultraviolet lamp (short and long wave), and hand magnets.

The separated samples were then analyzed by the following procedure:

1. Estimation of the percentage of minerals that fluoresce under ultraviolet (scheelite, zircon).
2. Estimation of the percentage of magnetic minerals (magnetite, pyrrhotite, and artifacts).
3. Examination of the remaining minerals using a binocular microscope.

Grains studied from the panned heavy concentrates were generally less than 1.0 mm in diameter, making identification difficult. All results from this study are considered tentative, until confirmed by more sophisticated methods (e.g., X-ray diffraction, electron microprobe).

RESULTS

Previous heavy mineral studies have identified a wide range of minerals found in the Clear Creek drainage including scheelite, hematite, pyrite, magnetite, cassiterite, and arsenopyrite (Placer Mining Industry Reports, see Table 3). Heavy minerals identified in samples collected for this study include pyrite, arsenopyrite, and galena, as well as magnetite, ilmentite, scheelite, cassiterite, zircon, garnet, and hematite (Table 4). Unlike most placer occurrences in the Yukon, the heavy mineral concentrates are not dominated by magnetite, in fact most samples contained less than a few percentage of magnetite. However, many samples were dominated by ilmenite, commonly greater than 40%. Ilmenite-rich samples were typically obtained from tributaries draining intrusive rocks, in particular Left and Right Clear Creek and Lewis Gulch. The dominance of ilmenite over magnetite results from the reduced nature of the intrusive rocks (i.e., ilmenite series granites).

Hematite is common, but rarely occurs in significant quantities. Although small grains were probably derived from oxidized occurrences of metallic minerals, large hematite nuggets are exotic having been introduced by pre-Reid glacial drift (J. Bond, pers. comm., 1999). Cassiterite occurs as a trace amount in most samples and is locally crystalline. Significant quantities of cassiterite reported from early mining efforts, attest to a proximal source. Scheelite occurs as trace to a few percent in most samples but locally is greater than 5% from Josephine Creek and near the headwaters of Left Clear Creek. These localities are all downstream of known intrusive bodies (98TLA08, 14, 29) or skarn zones (98TLA13). Another isolated locality reported to have abundant scheelite (Clear Creek Resources, pers. comm., 1998) is near the bend on Left Clear Creek. This locality, currently being mined, is proximal to both the Grizzly and Barney stocks (Fig. 1).

Sulphide minerals were absent from most samples studied for this project. Where present, pyrite occurs as cubes (singular, twinned, and intergrown) as well as fine-grained granular aggregates. Some pyrite crystals are in quartz and grey schistose

Table 3. *A summary of previously reported heavy mineral data of placer deposits of the Clear Creek drainage:*

Locality	Fineness	Heavy minerals recovered (previously reported)								Reference
		galena	scheelite	hematite	pyrite	magnetite	cassiterite	arsenopyrite	Other minerals	
Clear Creek (downstream from confluence of right and left forks) 63°46' 137°16'	820 889								garnet	Placer Mining Section (1993) LeBarge and Morison (1990)
Squaw Creek 63°47' 137°28'	870									Debicki (1983b)
Upstream from Squaw Creek 63°45' 137°20'	840-850								black sand	Placer Mining Section (1991)
downstream from Squaw Creek 63°46' 137°34'	830						x		black sand	Placer Mining Section (1996)
downstream from Squaw Creek 63°47' 137°27'	840			x	x				black sand	Placer Mining Section (1991, 1993)
63°45' 137°15'	840			x					chalcopyrite	Placer Mining Section (1991)
Barlow Creek 63°48' 137°37'				x		x	x		sulphides	Placer Mining Section (1993)
Left Clear Creek			x			x	x	x		Kreft (1993)
1.6 km upstream from fork 63°46' 137°39'			x	x		x			barite	Placer Mining Section (1991)
7-9 km upstream from fork		x	x	x	x	x	x	x	ilmenite, garnet, barite, tourmaline, zircon	Aho (1949)
65 Pup 63°49' 137°19'	960					x				Placer Mining Section (1991, 1993)
Barney Pup 63°49' 137°15'	820-860					x	x		cinnabar	Debicki (1983b), Kreft (1993)
Bell Creek 63°51' 137°20'									black sand	Kreft (1993)
63°50' 137°07'	790-820									Placer Mining Section (1991)
Headwaters of left fork 63°51' 137°06'	730 820					x				LeBarge & Morison (1990); Placer Mining Section (1991)
Right Clear Creek			x	x		x	x			Kreft (1993)
1.6 km upstream from junction of the forks 63°47' 137°14'	820	x		x	x	x			(abundant pyrite)	Placer Mining Section (1996)
~ 3 km up from forks			x		x	x	x		ilmenite, garnet, zircon	Aho (1949)
Quartz Creek 63°46' 137°13'	790-820	x						x		Placer Mining Section (1996)
0.8 km upstream from Quartz Creek 63°46' 137°00'	840		x	x		x				Placer Mining Section (1991); Mining Inspection Division (1998)
Queenstake Resources on Right Clear Creek 63°47' 137°15'	828-860		x				x			Debicki (1983b)

Note: Galena on Right Clear Creek may be derived from galena-quartz veins near the Vancouver Creek stock (Murphy, 1997).

rock fragments. Arsenopyrite also occurs as singular and intergrown prismatic, striated crystals. Notable amounts of sulphide minerals occurred in the following samples (refer to Fig. 1 and Table 3 for sample locations):

- 98TLA05a — Fresh pyrite cubes (singular, twinned, and intergrown) are striated, or occur as compact granular aggregates; some in quartz.
- 98TLA26 — Pyrite (10-15%) occurs as fresh crystals, striated, cubic (singular, twinned) and granular aggregates (5%). Arsenopyrite (5%) occurs as elongate, striated, prismatic crystals that are brassy to silvery in colour; some twinned crystals.
- 98TLA28 — Fresh (bright metallic luster) pyrite cubes (singular, twinned, and intergrown masses), few crystals iridescent with green hue, also pseudomorphs of pyrite replaced by goethite and hematite and fine-grained granular aggregates. Some pyrite is attached to grey schist and quartz.

Figure 5. *Gold nuggets from the upper reaches of Left Clear Creek. The largest nugget reported from Clear Creek (7 oz) is shown in the bottom right hand corner.*

- 98TLA29 — Pyrite (15-20% of sample) is fresh, trace amounts of pyrite pseudomorphs replaced by goethite and hematite, or as pyritohedrons, cubes, and fine-grained aggregates of pyritohedrons (attached to quartz and/or grey schist). Galena (tr-1%) occurs as very fresh and silvery cubic crystals.

The high percentage of sulphide minerals in these samples, their association with quartz and schist, and degree of angularity suggests a probable derivation from a nearby source.

Zircon are present in trace amounts in most samples, as is sphene, but in higher quantities. Both are common minerals in felsic intrusive rocks, but are also present in the metasedimentary rocks. The highest quantities (>10%) of sphene are in drainages below intrusive rocks, notably creeks proximal to the Rhosgobel stock. Garnet is common and may be present as metamorphic minerals in the skarn (Sample 98TLA13), but has been observed (sparsely) in intrusive rocks. The Josephine Creek drainage also shows an appreciable amount of ilmenite, suggesting a close relationship may exist with the gravel and the intrusive bodies.

High percentages of magnetite may be indicative of drainages with retrograde skarn occurrences. Samples containing significant ilmentite, with sphene and zircon may be indicative of drainages with unmapped intrusive rocks. Significant hematite may indicate creeks draining pre-Reid tills.

GOLD DESCRIPTION (OBSERVATIONS AND ANALYTICAL)

On the main drainage of Clear Creek, placer gold is reported as fine and flat with few nuggets (Placer Mining Section, 1993, 1996; Mining Inspection Division, 1998). Gold recovered by the dredge on Right Clear Creek is generally tabular and worn, although some grains were rough and hackly (Debicki, 1983b). Less than 10% of dredged gold was coarser than No. 10 mesh (1.6 mm) while 90% was between No. 70 (0.19 mm) and No. 10 (1.6 mm) mesh (Gutrath, 1986). Gold retrieved from Left Clear Creek has been described as “fine and flat, though closer to the headwaters gold is coarser and rougher” (Kreft, 1993). Gold from 65 Pup consisted of coarse nuggets with 75% larger than No. 4 mesh (4.7 mm) mined from a 7 to 8 foot (2.1 to 2.4 m) thickness of channel gravel overlying decomposed schistose bedrock (Placer Mining Section, 1996). Overall, gold in the left and right forks of Clear Creek tends to be coarser than gold further downstream and west of the Two Sisters Batholith. The largest known nugget from the Clear Creek drainage, weighing 7 oz (218 g), was found near the headwaters of Left Clear Creek (N. Harper, pers. comm., 1998; Fig. 5).

Upon close inspection of the grains under a binocular microscope it is evident that there is a larger variation in the shape and roundness of the gold grains than previously reported

Table 4. *Summary of heavy mineral analysis of samples collected from the Clear Creek drainage. Samples 98TLA01 to 25 are panned concentrates, 26 to 29 are placer concentrates.*

Sample #	Locality/Operator	Easting UTM (NAD 27)	Northing UTM (NAD 27)	Yield	Coatings[1]	% dark mins[2]	rock frag	magnetite	scheelite	zircon	pyrite
98TLA01	Left Clear Creek, trib near Lewis deposit	394190	7080513	0.34 cm^3	very little		65-75%	5-15%	tr	1-2%	tr - pseudomorphs
98TLA02	Left Clear Creek, Harper's	394595	7080310	0.28 cm^3	very minor limonite	70%	50-60%	5-10%	tr-1%	tr-1%	1 fresh cube -striated; 1-2% pseudomorphs
98TLA03	65 Pup	397050	7079011	0.028 cm^3	limonite	10%	70-80%	tr	tr	2-5%	1% fresh cubes; pseudomorphs
98TLA04	Tributary east of Squaw Creek, off Clear Creek	381314	7075291	0.057 cm^3		40%	5-15%	10-20%	tr	1%	1% cubes; pseudomorphs
98TLA05a	Left Clear Creek, below Barney stock	387913	7080621	0.11 cm^3	very minor limonite	< 5%	1-5%	tr-1%	tr	1-5%	40-60% fresh cubes, striated, aggregates
98TLA05b	Below exposure of Barney stock	387913	7080621	0.057 cm^3	very minor limonite	70-80%	10-20%	tr	5-10%	1-2%	1 fresh cube, 2 pseudomorphs
98TLA06	Barney's Creek, Left Clear Creek	388178	7077337	0.11 cm^3		5-10%	60-70%	1-2%	tr	1-5%	1-3% pseudomorphs
98TLA07	Trench in scree below Rhosgobel stock	398452	7081589	0.028 cm^3	major limonite	90-95%	50-60%	tr-1%	tr	tr	
98TLA08	Left Clear Creek, junction of streams at upper end	396785	7081527	0.023 cm^3	heavy limonite	20-30%	5-10%	tr	20-40%	tr	tr fresh
98TLA09	Lewis Gulch	394365	7082786	0.05 cm^3	limonite	60-75%	5-10%	tr	1-2%	tr-1%	tr-1% cubes, pseudomorphs
98TLA10	Lewis Gulch, confluence near headwaters	395741	7084093	0.057 cm^3	limonite	60-80%	1-5%	tr-1%	1%	1%	tr pseudomorphs
98TLA11	Clear Creek, beyond dredge	396785	7076442	0.17 cm^3	minor limonite	80-90%	1%	1-5%	1-5%	1%	
98TLA12	Clear Creek, beyond dredge	396785	7076442	0.20 cm^3	limonite	90-95%	2-5%	1-5%	1-2%	1-2%	
98TLA13	Harper's Creek	396337	7079975	1.13 cm^3	very minor limonite	40-50%	5-10%	tr-1%	1-2%	tr	1% pseudomorphs, 1 fresh
98TLA14	Left Clear Creek, Harper's pay dirt	393461	7080800	0.17 cm^3	limonite	40-50%	10-20%	1-2%	10-15%	tr	tr - pseudomorphs
98TLA15	65 Pup	384642	7078813	0.11 cm^3	limonite	30-40%	75%	tr	<tr	tr-1%	1-5% pseudomorphs
98TLA16	Quartz Creek (across from Board's camp)	390502	7074107	0.39 cm^3		75-85%	70-80%	5-10%	<tr	1-5%	1% pseudomorphs
98TLA17	Smith Gulch, Klassen's (Clear Creek)	384593	7074710	0.11 cm^3	limonite	60-70%	5%	5%	tr	1-2%	1% pseudomorphs
98TLA18	Clear Creek, 13 Pup, Klassen's	387078	7074491	0.11 cm^3	minor limonite	60-70%	20%	2%	<1%	tr	1-2% pseudomorphs
98TLA19	Squaw Creek, Clear Creek, Scott's	378314	7075645	0.028 cm^3		75-90%	75-85%	1-3%	<tr	1%	1-2% pseudomorphs
98TLA20	Trib off Left Clear Creek,	388552	7081817	0.057 cm^3	limonite	20-30%	70-80%	1-5%	tr	tr	
98TLA21	Josephine Creek	400202	7084842	0.10 cm^3	major limonite	80-90%	50-60%	tr	1-5%	1%	tr pseudomorphs (single, twinned)
98TLA22	Josephine Creek	399388	7084446	0.028 cm^3	limonite	90-95%	40-50%	tr	5-10%	tr	tr, fresh; tr pseudomorphs
98TLA23	Josephine Creek	399360	7084584	0.11 cm^3	limonite	85-95%	10-20%	tr	1-5%	tr	tr, cubes
98TLA24	Lewis Gulch near confluence with Left Fork	393200	7081367	0.39 cm^3	limonite	85-95%	90%	tr	tr	tr	
98TLA25	Left Clear Creek, Blackstone Placer Mining	394854	7080663		magnetic Fe-stain			<1%	1-2%		
98TLA26	Right Clear Creek, Prospecta Mining Ltd., Board's	393706	7074724		iron-stained limonite, difficult to distinguish minerals	>50%	2-5% schist	tr	1%	tr	10-15% fresh, cubes, aggregates, crystalline, striated
98TLA28	Left Clear Creek, Clear Creek Resources	388407	7081400			10-15%	20-40%	tr	1-2%	tr	2-5% pseudomorphs, 25-40% fresh euhedral, cubes, pyritohedrons
98TLA29	Headwaters of Left Clear Creek, Blackstone Placer Mining, Harper's	394945	7080610			5-10%	5%	1%	65-80%	tr	5-7% cubic and pyritohedron

tr = trace amounts (<1%)
1 = coatings on the minerals causing difficulty in identification
2 = overall percentage of all dark minerals (i.e., magnetite, ilmenite, rock fragments)

Table 4. *...continued*

Sample #	cassiterite	garnet	hematite	ilmenite	sphene	hypersthene	epidote	anatase	pyroxene?	tourmaline?	gold	Other notes
98TLA01	tr	<tr		5-10%	1%	1%		<tr	1-2%	present		
98TLA02		< tr	1-5%	5-15%	tr	tr	tr					
98TLA03	tr	< tr		5-10%		1-2%	tr			tr - 1%		
98TLA04	tr	tr-1%	tr?	40-60%	1 grain	tr-1%		tr				
98TLA05a				1%	tr	tr	tr			2-5%		trace arsenopyrite
98TLA05b	tr			70-80%	1-5%	1%	tr	tr	1-2%	1-5%	4 grains, subcrystalline (0.1-0.2 mm)	
98TLA06	tr			1-5%		tr						
98TLA07				30-40%	tr	tr	tr		1-2%			
98TLA08	tr		1-2%	20-25%	15-20%	tr			tr	5%	3 grains; crystalline + quartz, subcrystalline (0.1, 0.2, 0.3 mm)	
98TLA09	< tr			65-75%		1%				tr		mins
98TLA10				60-80%	1-2%	tr					6 grains, sub-crystalline- crystalline	
98TLA11	tr	tr		85-90%	1 grain	tr-1%		tr	tr			
98TLA12	tr	1-2%		75-90%	1 grain	tr-1%		< tr	1-2%		1 grain, nugget (0.42 mm), subround	
98TLA13	tr-2%	2-5%		20-25%	25-30%							20-25% pyroxene? minerals
98TLA14	tr			30-40%	1-5%	1%					14 grains, flat, nugget, quartz attached (0.1 - 1.0 mm)	
98TLA15	< tr			1-5%		1-2%		< tr				
98TLA16	tr-1%	< tr		5-10%	tr	1-5%		< tr				
98TLA17	tr	1-5%		75-85%		1-3%		tr				
98TLA18	tr -2%	< tr		50-60%	tr	1-5%			tr	1%	5 grains flattened, subcrystalline	
98TLA19	tr-1%			5-10%		1%		tr		tr		
98TLA20		< tr		1-2%		tr				2-5%		
98TLA21	tr		1-5%	15-20%	tr-1%	tr		< tr	tr	1-2%	1 grain, crystalline (0.1 mm)	
98TLA22			5-10%	40-50%	1-3%	tr			tr	1-2%	1 grain, rod-shaped, rounded (0.15 mm long)	
98TLA23	< tr	< tr		60-70%	tr	tr			2-5%			
98TLA24	tr					tr	tr	< tr	2-5%	5%		
98TLA25												
98TLA26	present	tr (pink)	present	15-20%							crystalline, nugget, quartz attached (range 0.1 - 2.3 mm)	5-7% galena, 5% arsenopyrite, 2-5% unknown orangy-pink translucent mins, 20-30% orange, dull, non-crystalline minerals
98TLA28		2-5%	2-5%	5-10%							2 large grains (1.8 mm) mostly quartz with gold wrapped around, 2 small grains (0.4 mm) with quartz, crystalline to subcrystalline	unidentified orangy-pink translucent minerals, translucent white minerals
98TLA29		2-5%	tr-1%	5-10%							average 0.8-1.4 mm (0.1-2.0 mm)	trace galena, possible arsenopyrite

(Aho, 1949; Placer Mining Section 1991, 1993, 1996). Gold grains noted within panned heavy mineral concentrates in this study range from 0.1 to 1.0 mm in diameter and are sub-crystalline to crystalline (Table 5). Gold nuggets retrieved from sluice boxes are commonly $^{3}/_{4}$ to $1^{1}/_{2}$ oz (23 to 47 g), according to the placer miners. Gold grains observed in samples collected from Clear Creek range in shape from flat flakes to spheroidal forms and from well-rounded to crystalline (or hackly; Fig. 6). The percentage of gold grains with attached quartz varies between samples, with no apparent trend in distribution. These grains are typically sub-crystalline to crystalline (Table 5).

Panned samples containing gold typically contain a high percentage of ilmenite. Sample TLA9808, near the headwaters of Left Clear Creek, contained three grains of sub-crystalline to crystalline gold as well as fresh pyrite cubes and notable amounts of sphene, suggesting probable derivation from mineralization in or adjacent to the Rhosgobel stock.

Variations in placer gold fineness (purity) between creeks may indicate that the gold was derived from different lode sources. Fineness in Clear Creek gold varies ranging from 730 to 960 (Table 3). On the right fork, fineness averages 800, with a range of 784 to 860. The purity appears to be lower in the upstream limits. Purity of gold on the left fork ranges between 730 and

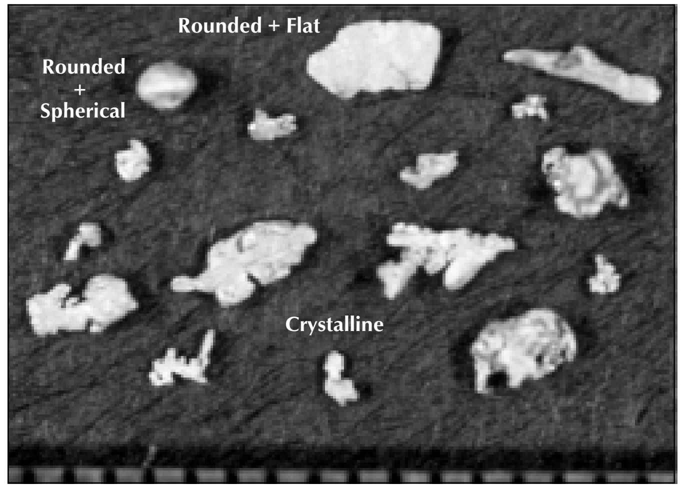

Figure 6. *Examples of various morphologies of placer gold from the right fork of Clear Creek. This photo illustrates the variability of the gold, ranging from rounded to crystalline and spherical to flat. Each tick on the scale represents 1 mm.*

Table 5. *Gold shape and roundness distribution for samples collected from active placer mining operations during the 1998 field season from Clear Creek. Sample number 98TLA26 is from Right Clear Creek, samples 98TLA28 and 29 are from Left Clear Creek. Gold grains were classified by presence of quartz, degree of roundness, and overall shape (flakes, branching, spheres, etc.). Staining on the gold grains is typically red to orange although occasionally black.*

98TLA26 (UTM 393706 7074724 (NAD27))

Gold Grains	quartz	no quartz	flat	intermediate	spherical	branched	aggregate	stained	total
round	0	32	8	12	10	2	0	9	19%
subround	5	61	16	11	8	12	19	21	39%
subcrystalline	17	37	6	5	6	21	16	25	32%
crystalline	9	9	1	0	7	9	1	7	11%
Total	**18%**	**82%**	**18%**	**16%**	**18%**	**26%**	**21%**	**36%**	

98TLA28 (UTM 388407 7081400 (NAD27))

	quartz	no quartz	flat	intermediate	spherical	Total
round						0%
subround		1			1	17%
subcrystalline	1				1	17%
crystalline	3			3		50%
Total	**80%**	**20%**	**0%**	**60%**	**40%**	

98TLA29 (UTM 394945 7080610 (NAD27))

Gold Grains	quartz	no quartz	flat	intermediate	spherical	branched	stained	Total
round	1	7	0	2	6	0	5	13%
subround	2	19	3	5	12	0	11	31%
subcrystalline	11	10	1	6	8	6	8	29%
crystalline	13	6	1	5	7	6	8	27%
Total	**39%**	**61%**	**7%**	**26%**	**49%**	**18%**	**34%**	

840. Fineness of gold retrieved from dredging operations in the 1980s averaged 800 (Gutrath, 1986; Table 3). No trends are apparent with data available. Sixty-five Pup is anomalous within the Clear Creek drainage, having a reported gold fineness of 900 to 960, making it the purest gold in the Yukon (Kreft, 1993). This may reflect a lode source of gold different than that contributing most gold to the Clear Creek drainage. Alternatively, gold with high fineness may be a function of considerable *in situ* leaching of the non-gold elements (Knight and McTaggart, 1990).

Variations in the shape, degree of roundness, and fineness of the placer gold from the Clear Creek drainage suggests that there are multiple sources and transporting mechanisms for the gold. A majority of the gold appears to be well travelled with a high degree of roundness and a general lack of quartz. Knight et al. (1994) recognized that gold particle roundness and flatness increase rapidly within the first 5 km of transport from the source, with flatness being the most reliable distance estimator. Hammering is the main cause of shape change in fluvially transported gold particles forming flattened grains (Knight et al., 1994). Some of the gold, with its sub-crystalline to crystalline form and association with quartz appears to be derived from a proximal source.

Successive glacial activity within the Clear Creek drainage likely played an important role in the distribution of gold from its source. Alpine glaciers, present during the pre-Reid, Reid, and McConnell glacial periods, and subsequent melt waters during interglacial periods travelling down and into the valleys, were likely important transport media for gold movement. The presence of large amounts of galena on Quartz Creek and along the right fork of Clear Creek suggests that the pre-Reid ice sheet or related meltwater may have transported galena from quartz veins near the Vancouver Creek stock. Alternatively, a local concentration of galena occurs on the right fork.

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APPENDIX. REVIEW OF REPORTED ACTIVITIES ALONG CLEAR CREEK

YEAR	ACTIVITY
1900	T. Spritzer and J. Gergich – began work on discovery claim (Kreft, 1993)
1931	T. Spritzer and J. Gergich – staked a new discovery claim near the forks causing a small rush in the area (Kreft, 1993)
1936	Fairbanks Exploration Co. – explored Clear Creek
1937	Fairbanks Exploration Co. – started prospecting at the mouth of Barlow Creek with a light drill, but the results were not satisfactory as the drill proved unsuitable for the type of ground (Bostock, 1938)
1938	Dumont Brothers and Mr. E.N. Patty (Manager for General A.D. McRae) – Clear Creek
1939	March – Canadian Placers, Ltd., started prospecting on the left fork of Clear Creek (Patty = manager, O'Neill = superintendent)
1940	A complete mining unit for this operation was landed by boat on the north fork of Stewart River (Bostock, 1941)
1942-1952	Dredge (Clear Creek Placers Ltd.) operated on left fork of Clear Creek
1953-1956	Dredge (Clear Creek Placers Ltd.) operated on right fork of Clear Creek
1956	G. Fant and I. Norbeck mined ground on left Clear Creek optioned from Clear Creek Placers Ltd. (recovered 289.49 fine oz gold; Debicki, 1983)
1957	G. Fant and I. Norbeck mined on the left fork on a few claims of their own and ground leased from Clear Creek Placers (recovered 376.84 fine oz gold; Debicki, 1983)
1958	Fant and Norbeck continued mining Left Clear Creek, retrieving 217.35 fine oz gold. They ceased mining in 1958 due to low grades, moving to Hunker Creek (Debicki, 1983)
1961-1962	G. Heitman and H. Netzel mined below the main fork on Clear Creek. The ground mined at this time was ground previously stripped in preparation for dredging.
1963	G. Heitman and H. Netzel, F. Caley and G. Caley (Left Fork)
1964	Heitman and C. Janus
1973	Six operations were active on Clear Creek: William Scott/Larry Logie /V. Norby (Clear Creek Gold Mines) mined on the left fork near Barney Pup and Terry Thompson *et al.* (downstream from Squaw), W. Malicky *et al*. (upper part of left fork), C. Ames (Squaw Creek)
1974	William Scott/L. Logie (Clear Creek Gold Mines) and A. Genier/T. Thompson (mined side pay adjacent to dredge tailings just upstream from Barney Pup)
1975	W. Genier and T. Thompson (upper part of left fork), Clear Creek Gold Mines (mouth of Barney Gulch)
1976	Clear Creek Gold Mines (W. Scott and L. Logie) (Barney Gulch); T. Thompson and W. Genier (2000 ft downstream of Lewis Gulch) and G. Regimbald (4 mi upstream from mouth of Barlow)
1977	Clear Creek Gold Mines (W. Scott and L. Logie)
1978	Five operations were active — Birch Industries, Crescent Mines Ltd., Clear Creek Gold Mines (Barney Pup, 65 Pup), Blackstone Placer Mining (left fork), T. Bazylinski (left fork),
1979	Five operations were active — Crescent Mines Ltd., R. Lazotte and W. Genier, Clear Creek Gold Mines (65 Pup), Blackstone Placer Mining (left fork), T. Bazylinski (left fork), Arch Creek Mining Ltd. and Canada Tungsten Mining Corp. (Josephine Creek)
1980	The price of gold more than doubled to $800/oz. Seven operations were active – Crescent Mines Ltd., Squaw Creek Mining (Squaw Ck), Sundance Gold Ltd., R. Lazotte and W. Genier, Clear Creek Gold Mines (65 Pup), Blackstone Placer Mining (left fork), T. Bazylinski (left fork), Arch Creek Mining Ltd. and Canada Tungsten Mining Corp. (Josephine Creek). The dredge was acquired by Queenstake Resources Ltd.
1981	Nine operations were active — Barlow Lake Gold Mines Ltd., Raleigh Energy Corporation, Dawson Mining Equipment Ltd. (Zinc Ck), Crescent Mines Ltd., Squaw Creek Mining (Squaw Ck), Sundance Gold Ltd, Blackstone Placer Mining (left fork), T. Bazylinski (left fork), Queenstake Resources (right fork), Arch Creek Mining Ltd. and Canada Tungsten Mining Corp. (Josephine Creek)
1982	Seven operations were active — Dawson Mining Equipment Ltd. (Zinc Ck), Litchfield mining (Barlow Ck.), Crescent Mines Ltd., Squaw Creek Mining (Squaw Ck), General Mining (left fork), Blackstone Placer Mining (left fork), Queenstake Resources (right fork), Arch Creek Mining Ltd. and Canada Tungsten Mining Corp. (Josephine Creek)
1983	Eight operations were active — D. Buerge (Zinc Creek), Barlow Creek Mines (Barlow Creek), Auriferous Placers (Squaw), 3641 Yukon Ltd. (left fork), J. Scott (65 Pup), Blackstone Placer Mining Ltd. (left fork), T. Bazylinski (left fork), Queenstake Resources (right fork)

continued...

APPENDIX (continued)

YEAR	ACTIVITY
1984	Nine operations were active — D. Buerge (Zinc Creek), Barlow Creek Mines (Barlow Creek), Auriferous Placers (Squaw), 4757 Yukon Ltd., 3641 Yukon Ltd. (left fork), J. Scott (65 Pup), Blackstone Placer Mining (left fork), T. Bazylinski (left fork), Queenstake Resources (right fork)
1986	Two operations were active — R.E. Moore (Barlow), Queenstake Resources (right fork)
1987	Five operations were active — 4757 Yukon Ltd., T. Bazylinski (left fork), Blackstone Placer Mining (left fork), Van Bibber Placer, Queenstake Resources (right fork)
1981-1987	The dredge, the only bucket-line dredge, operated full-time. In 1987 the dredge terminated its mining activities on Clear Creek due to low gold grades (INAC, 1988).
1988	Four operations were active — 4757 Yukon Ltd., T. Bazylinski (left fork), Blackstone Placer Mining (left fork), Van Bibber Placer
1989	Eleven operations were active — E. Chesney (left fork), 4757 Yukon Ltd., Prospecta Contracting Ltd. (right fork), West Coast Paving, Nechako Contracting, T. Bazylinski (left fork), Blackstone Placer Mining (left fork), Gordon's Placer, N. Duncan, J. Scott (65 Pup), Van Bibber Placer
1990	Ten operations were active — E. Chesney (left fork), 4757 Yukon Ltd., Prospecta Contracting Ltd. (right fork), West Coast Paving, Nechako Contracting, Blackstone Placer Mining (left fork), Sister Resources, Gordon's Placer, J. Scott (65 Pup), Van Bibber Placer
1991	Seven operations were active — R. Jarvis, R. Lizotte (Barlow), West Coast Paving, Blackstone Mining (left fork), Sisters Resources, 4757 Yukon Ltd., J. Scott (65 Pup)
1992	Seven operations were active — R. Jarvis, R. Lizotte (Barlow), West Coast Paving, Blackstone Mining (left fork), Sisters Resources, 4757 Yukon Ltd., J. Scott (65 Pup)
1993	Nine operations were active — W. Wasylenko, R. Lizotte (Barlow), West Coast Paving, 4757 Yukon Ltd., Blackstone Placer Mining (left fork), L. Austin (Quartz Ck.), Prospecta Mining (right fork), J. Scott (65 Pup), Stoney Mines (65 Pup)
1994	Nine operations were active — W. Wasylenko, R. Lizotte (Barlow, right fork), West Coast Paving, 4757 Yukon Ltd., Blackstone Placer Mining (left fork), L. Austin (Quartz Ck.), Prospecta Mining (right fork), J. Scott (65 Pup), Stoney Mines (65 Pup)
1995	Eight operations were active — W. Wasylenko, R. Lizotte (Barlow), D. Kosuta, J. Scott, 4757 Yukon Ltd., Blackstone Placer Mining (left fork), Prospecta Mining (right fork), L. Austin (Quartz Ck.)
1996	Nine operations were active — W. Wasylenko, R. Lizotte (Barlow), D. Kosuta, J. Scott (65 Pup), 4757 Yukon Ltd., Stoney Mines (65 Pup), Blackstone Placer Mining (left fork), Prospecta Mining (right fork), L. Austin (Quartz Ck.)
1997	Five operations were active — W. Wasylenko, J. Scott (65 Pup), 4757 Yukon Ltd., Blackstone Placer Mining (left fork), Prospecta Mining (right fork)
1998	Blackstone Placer Mining (left fork), Prospecta Mining (right fork), Clear Creek Resources (left fork)