Proximal gold-cassiterite nuggets and composition of the Feather Creek placer gravels: clues to a lode source near Atlin, B.C.

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INTRODUCTION

Placer gold was discovered on Pine Creek east of Atlin in 1898 (Robertson, 1899). Since that time, exploring for a lode source for the rich Atlin placers has been a local preoccupation. Traditionally, lode exploration has focused within and adjacent to the eye-catching, bright orange, extensively quartz-veined listwanitic alteration zones in the Atlin placer camp. These zones of quartz, iron carbonate and mariposite (Cr-mica), which comprise the listwanite alteration assemblage, contain sporadic visible gold. So far, however, there has been no significant lode-gold production from such settings, in contrast to similar alteration zones in the famous Alleghany district of California (Böhlke, 1999).

Numerous lode-gold showings are known in the Atlin area, although the character of such mineralization is not in accordance with the richness of the Atlin placers and certainly not with the coarseness of some of the nuggets recovered. Also there are no producers of lode gold known within the Atlin camp*. The question remains: "What was the source of the Atlin placers?" In 1959, the Geological Survey of Canada published the Atlin Map-Area memoir by J. Aitken that included a comprehensive synopsis of placer mining activity in the Atlin camp. About the source of the gold, Aitken (1959) concluded: "…*it is significant that many acres of bedrock in the most favourable area have been stripped in the course of placer mining without a single promising vein being uncovered…. It appears likely, therefore, that the known lodes of the area and perhaps some of the multitude of barren quartz veins are the roots of lodes, now completely eroded, that may have been the source of the placer gold*." (page 78). A contemporary view by Ash (2001) is more specific about the host lithologies, suggesting an ophiolitic association, but he comes to essentially the same conclusion: "*The placers are considered to be derived from quartz lodes previously contained within the ophiolitic crustal rocks*."(page 25). Implicit in these assertions is that coarse gold has undergone transport in a dominantly vertical direction (eluvial); from its eroded source somewhere directly above or slightly upstream of the point in the creek bed from which the gold was recovered. Such an assertion requires that the process(es) which transported boulders up to 4 metres across into lithologically alien streambeds, did not result in long distance transport of gold nuggets.

Figure 1. View to the northeast, over the broad Feather Creek valley. The placer workings are located near the centre of the photo.

The total erosion hypothesis advocated by Aitken (1959) and total erosion of a listwanite-altered ophiolitic source by Ash (2001), have not been systematically tested, principally because the most obvious subject of investigation no longer exists. The fact that a viable lode-gold source has not been found after more than a century of searching, appears to support these hypotheses. Even if totally eroded, however, the source should leave some telltale traces in addition to placer gold. For example, altered ultramafic clasts would occur within pay gravels. The problem lies in avoiding background sources of the proposed host rocks; sources that may have nothing to do with the lode gold, but which

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* *The Imperial Mine is classified as a "past producer" in MINFILE (104N008), but only 3 kg of gold production was recorded, more than 90% from mining operations in 1899. Mining ceased in 1900. Gold was not in gold "ore", considering that "ore" is raw mineral matter from which elements can be extracted at a profit.*

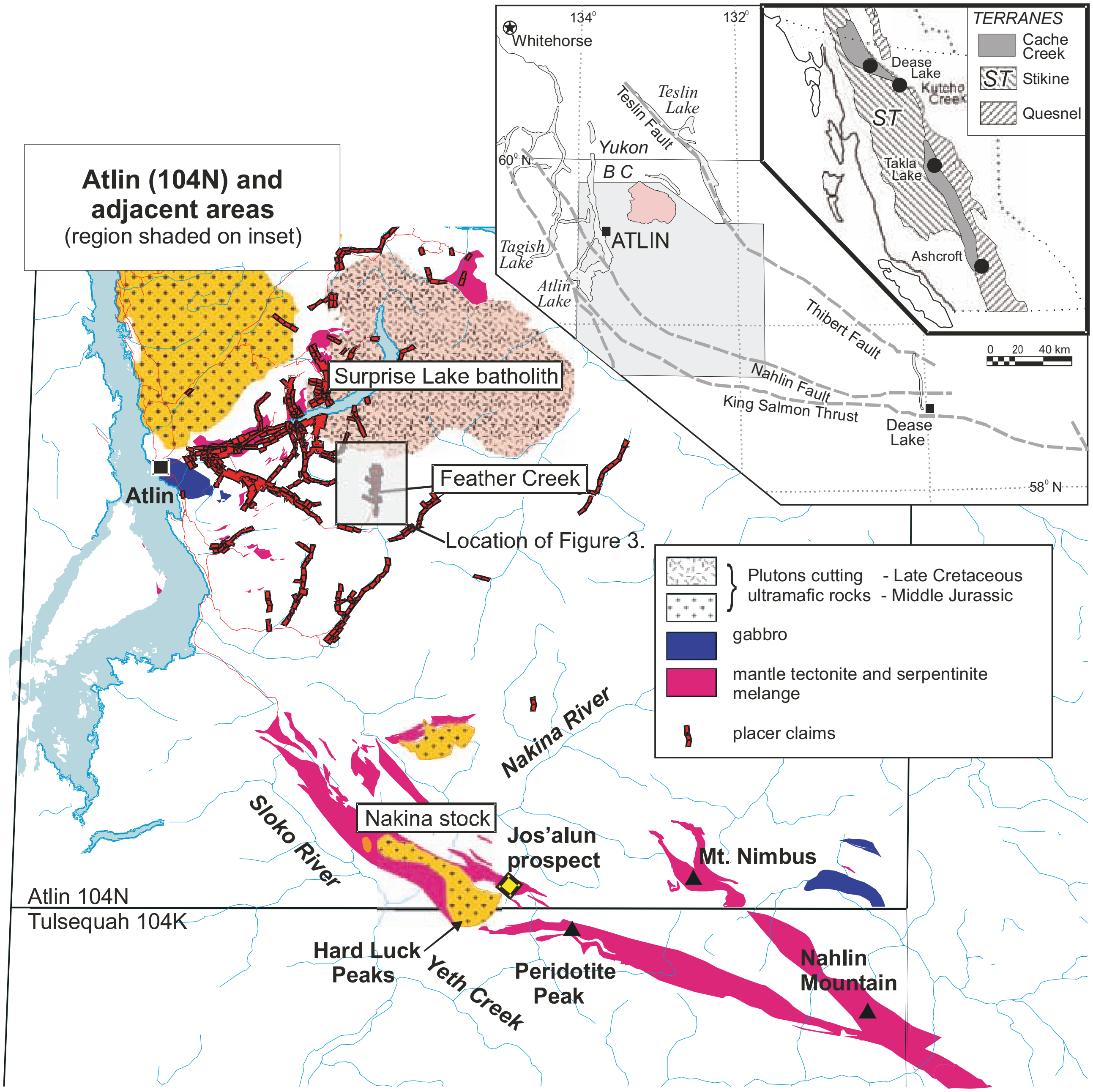

Figure 1. Location of Feather Creek, in relation to major intrusive bodies and mantle rocks.

find their way into the pay gravels. Lower portions of mature drainages are particularly afflicted by this problem. An additional level of uncertainty arises from the regional transportation of placer gold by glacial ice or ancient water-courses. Perhaps the placer gold itself carries a fingerprint of its source. Thus far, however, compositional analysis of gold nuggets within the Atlin camp has not yet revealed a fingerprint of the lode gold source (Ballantyne and MacKinnon, 1986). Mineral matter attached to the gold nuggets may however, provide insight into the gold source. We know of no prior attempt to characterize mineral matter included or intergrown with the Atlin placer gold to fingerprint its source, and consider this method a potentially fruitful avenue of investigation.

In our reconnaissance study we attempted, as much as possible, to remove the uncertainty of extraneous clast sources. We utilized a valley with dominantly local sediment (Levson, 1992), Feather Creek, to examine the composition of clasts comprising the gravels; within these gravels, coarse crystalline gold (not rounded by alluvial transport) is commonly recovered (Figure 7). Because crystalline gold is most probably not far traveled, we assume that it is from a single source. Nuggets from Feather Creek were examined visually to identify those with at-

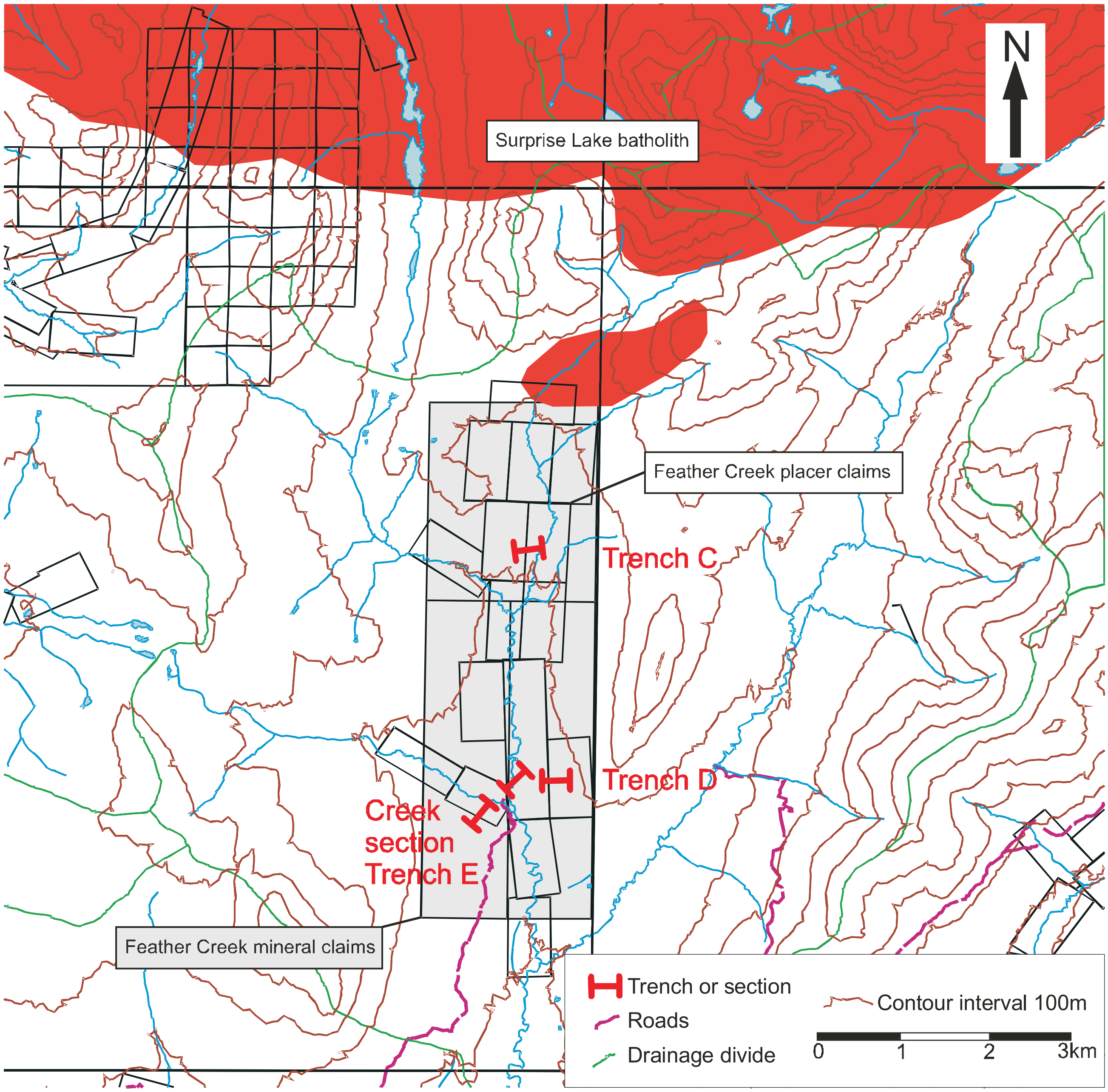

Figure 2. Feather Creek placer and mineral claims. Trench locations are shown by green star. For map location see shaded inset in figure 1.

tached, non-quartz mineral matter. Scanning Electron Microscope (SEM) and Energy Dispersive Spectroscopy (EDS) techniques were then used to analyze the mineral matter with the aim of acquiring a geochemical fingerprint for the geological host unit.

Our preliminary findings show that neither ultramafic nor listwanite are a significant source for river gravels in the Feather Creek placers as no ultramafite nor listwanite clasts (> 2 mm in diameter) could be found (Table 1). Furthermore, in all cases where Feather Creek gold is attached to non-quartz mineral matter, the mineral matter is primarily composed of tin oxide (cassiterite) as determined by SEM – EDS analysis. When considered in conjunction with the local and regional geology, these findings have important implications for lode gold exploration in the Atlin camp.

GEOLOGY

The Atlin placer camp is located in the northwest corner of the northern Cache Creek Terrane (Figure 1). In northwestern BC, the Cache Creek Terrane consists largely of an accreted complex of oceanic sedimentary strata of Mississippian to Jurassic age (Monger, 1975; Mihalynuk,

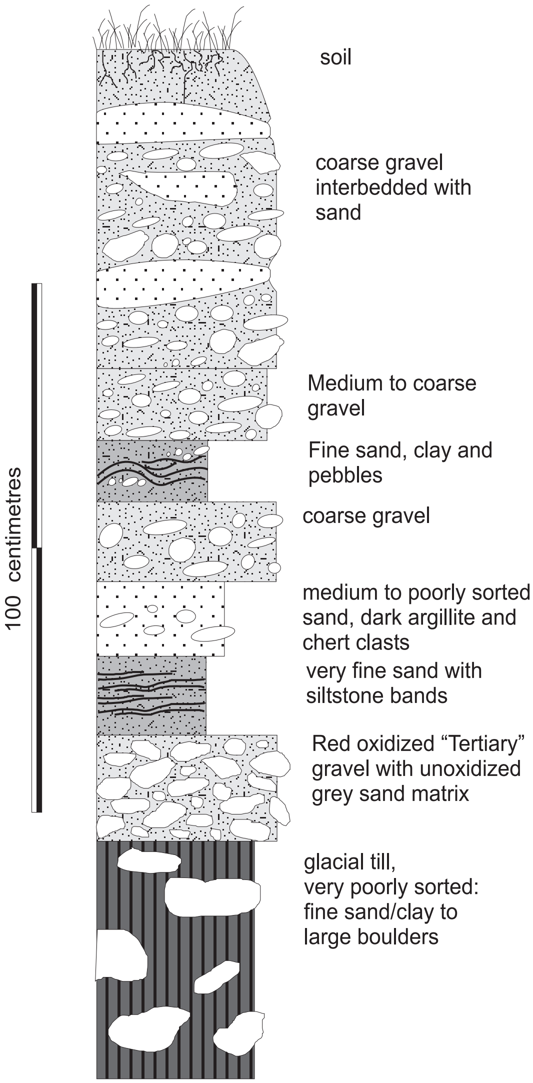

Figure 4a. Trench C, which had the highest gold value on the property (sample series MMI03-24-3). Total thickness represented is 1.85 m.

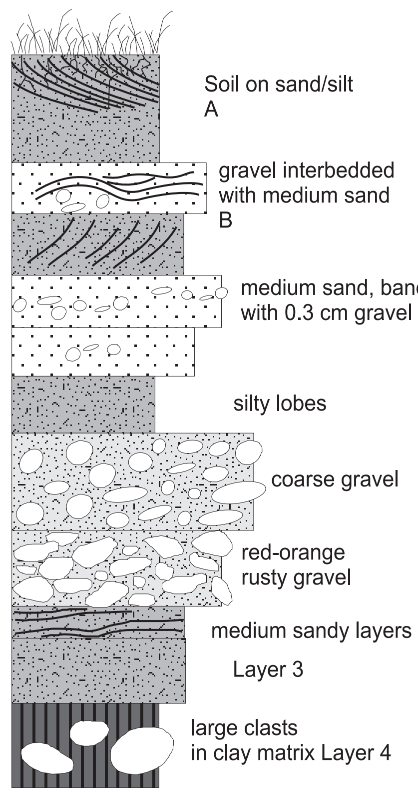

Figure 4b. Coomposite stream bank section D (KWI03-15-4) based upon the field notes of K. Wight (2003). Analyses of samples from this section included the second highest gold value that we obtained from the property.

1999) and ophiolitic rocks of Late Permian to Triassic age. Cache Creek strata were deformed and amalgamated to the ancestral continental margin between 174 and 172 Ma (Middle Jurassic) and were intruded by post collisional Middle Jurassic plutons (Mihalynuk et al., in press) and younger Cretaceous and Tertiary felsic intrusives (Mihalynuk, et al., 1992).

Near the townsite of Atlin, remnant ocean crust and upper mantle is referred to as the “Atlin Ophiolitic Assemblage” and is interpreted by Ash (2001) to have been thrust over pelagic meta-sedimentary rocks referred to as the “Atlin Accretionary Complex” (ibid.) which is the dominant lithology to the east. North of Atlin, both mantle and dismembered ophiolite are intruded by the Fourth of July Batholith (172 Ma) and, farther to the northeast, by the Surprise Lake Batholith (84 – 80 Ma; Mihalynuk et al., 1992; 2003a).

Units that underlie the lower stretches of Feather Creek drainage are ribboned and massive chert, quartz-bearing wacke, pyritic carbonaceous phyllite, volcanic conglomerate, and minor carbonate. The creek’s headwaters are underlain by the Surprise Lake batholith (Aitken, 1959; Figure 2) and its thermal metamorphic aureole, as shown by the aeromagnetic response (Dumont et al., 2001).

Quaternary glaciation affected the region, and the dominant ice flow direction is north-northwest (Levson, 2003). Younger alpine glaciers north and south of placer workings at Feather Creek carved cirques and steep valleys in mountainous granitic terranes. Feather Creek occupies a broad, fluvially modified glacial valley with a relatively high gradient (Figure 3).

TABLE 1. FEATHER CREEK PLACER GRAVEL COMPOSITIONS

Sample #	Sedimentary										
	b Chert	l. g Chert	t Chert	r Chert	v Chert	c Wacke	Wacke	r Wacke	Argillite	Limestone	Feldspar
KWI03-15-5B pebbles	56	3		1	4		3			6	4
KWI03-15-5B granules	833	32	52	10		50	31				
KWI03-15-4E pebbles	287	16		3	4		8			8	
KWI03-15-4E ganules	776	17	7	13			48			39	
KWI03-15-4D pebbles		9					2				
KWI03-15-4D granules		9					10		1		
MMI03-24-4B pebbles		2									
MMI03-24-4B granules		4				1		1			
MMI03-24-3 pebbles	194	7	5			5					
MMI03-24-3 granules	1058	40	35	5							
MMI03-24-2A pebbles		3	2			3	22				
MMI03-24-2A granules	405	208	24	10			6				

	Igneous					Metamorphic			Total Sample		Total	Total
	f Volcanic	FspPorph	Dioritic	Granitic	gr Volanic	Quartzite	Qtz-Vein	Meta - Wacke	Magnetic	**Weight**	Pebbles	Granules
KWI03-15-5B pebbles		3	2								5	
KWI03-15-5B granules	4	3	14	61		10	14	2	20	207. 0 g		128
KWI03-15-4E pebbles	4		4	3		5	4				20	
KWI03-15-4E ganules	8		5	25		100	13		5	345.0 g		156
KWI03-15-4D pebbles	4										4	
KWI03-15-4D granules							1	3		38.0 g		4
MMI03-24-4B pebbles									2		2	
MMI03-24-4B granules							1		10	2.9 g		11
MMI03-24-3 pebbles	2			2	2	2	6				14	
MMI03-24-3 granules	1			203		3	2			1144.9 g		209
MMI03-24-2A pebbles						2					2	
MMI03-24-2A granules				14		5	3			248.7 g		22

f = felsic, r = rusty, c = cherty, l.g = light grey, gr = green, b = black, t = tan, r = red, v = veined

METHODOLOGY

GEOCHEMICAL ANALYSIS OF FEATHER CREEK PLACER GRAVELS

Three trenches up to 2.5 m deep provide sections through unconsolidated material over fractured bedrock. These sections are similar (Figure 4) and at their base have rusty red, weakly cemented "Tertiary" gravels typically 25 cm thick, overlain by "Quaternary" lacustrine, alluvial and colluvial units, typically over a metre thick. Throughout the Atlin camp, red, oxidized gravels of assumed Tertiary age contain much of the placer gold. With the notable exception of some pay streaks along Spruce Creek, Quaternary gravel does not contain large concentrations of placer gold. Oxidized, red, angular and incipiently lithified gravels along Feather Creek resemble Tertiary gravel elsewhere in the Atlin camp, but it is underlain by poorly-sorted material

Figure 4c. Representative trench on Feather Creek showing a section of red angular alluvium, sandy clay and alluvial gravels.

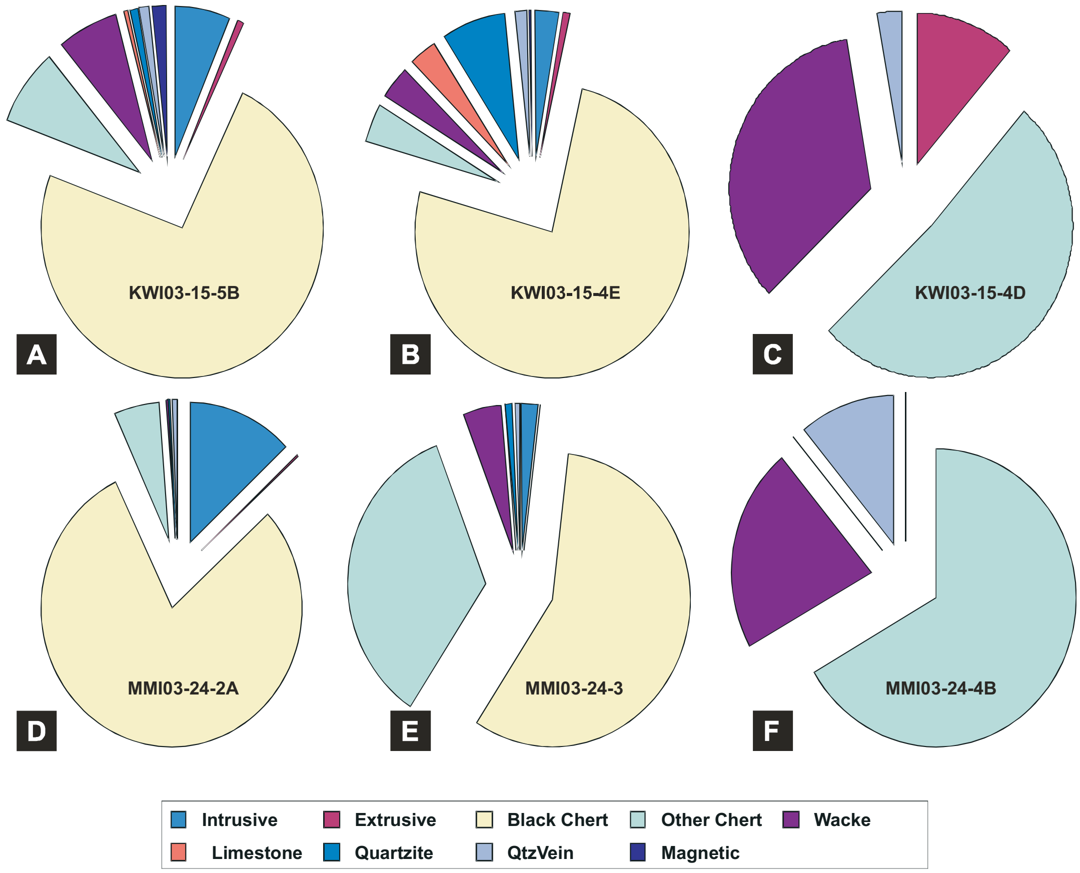

Figure 5. Clast counts for six samples; pebble and granule fractions are combined. Intrusive = diorite and granitoid; Extrusive = felsic volcanic, green volcanic, feldspar porphyry; Other chert = light grey, tan, red, and veined chert; Wacke = cherty-wacke, rusty wacke and grey wacke.

with clasts up to boulder size in a clay-rich matrix. We interpret this underlying material as glacial till. Hence, most of the sections that we sampled are probably Quaternary and younger in age. Representative samples, 1 – 2 kg, were collected from the three main units exposed in each trench. One composite sample was collected from a well exposed cut bank of Feather Creek as well as a sample from the sluice box clean up reject pile. In all, 15 samples were collected from Feather Creek. Analytical results from the 60 samples are reported in Tables 2 and 3.

Each of the fifteen samples was split into four size fractions: +10 mesh (>2 mm), -10 to +18 mesh (2 - ~1 mm), -18 to +80 mesh (1 – 0.2 mm) and -80 mesh (<0.2 mm). Resultant fractions were weighed with approximately half of the +10 mesh fraction reserved for clast identification. Grain mounts were made from a small proportion (~5%) of grains between -10 and +18 mesh to provide independent petrographic verification of clast compositions. Remaining material was reweighed. Approximately 50 g of material was split from each fraction using a Jones splitter and ground in a steel disk mill. Geochemical analyses of the “Tertiary” and “Quaternary” material was performed by inductively coupled plasma emission spectroscopy (ICPES) at ACME Analytical Laboratories Ltd., Vancouver; and by instrumental neutron activation analysis (INAA) at Activation Laboratories, Ancaster, Ontario.

The size of sample needed to accurately represent the gold content of an alluvial placer material is on the order of 2 m^3 per sample (Royle, 1987). The size of samples taken for this project were 0.02 m^3, therefore the concentrations of gold reported are not taken as representative of the grade on the property.

COMPOSITION OF ATTACHED MINERAL MATTER IN GOLD NUGGETS

Six gold nuggets with attached mineral matter (other than quartz) were obtained from the placer operation on Feather Creek. Each nugget was analyzed using a Hitachi S-3500N Scanning Electron Microscope (SEM) with an Oxford Instruments Link ISIS Energy Dispersive X-Ray Spectroscope (EDS) attached. All nuggets were attached to aluminum stubs with double-sided carbon tape. It was not necessary to apply carbon or gold coating to the electrically conductive samples. EDS analysis provided relative abundances of elements present. Elements identified during spectroscopic analysis of four of these nuggets are presented in Table 4.

TABLE 2. ENERGY DISPERSIVE SPECTROSCOPY (EDS) RESULTS FOR FOUR GOLD NUGGETS WITH ATTACHED, NON-QUARTZ MINERAL MATTER.

Sample Number	PSA03-1-1	PSA03-1-2	PSA03-1-4	PSA03-3-1
Elements present	**Au,** Sn, O (SnO_2 cassiterite), Si (quartz), Cl, Fe (oxide/ chloride coating?)	**Au**, Sn, O, (SnO_2 cassiterite) Si (quartz), Fe, Cu (in Au)	**Au**, Sn, O (SnO_2 cassiterite), Si (quartz), Th ($ThSiO_4$ thorite), Fe (surface coating?)	**Au**, Sn, O (SnO_2 cassiterite), Cl, Pb, C, Fe (surface coating?)

RESULTS

CLAST COUNTS

Fifteen samples were collected for analysis from three trenches, one exposed creek section and one from a pile of sluice box clean-up rejects. The +10 fraction was sieved to +5 mesh (> ~4 mm) and -5 to +10 mesh (~4 – ~2 mm). The +5 size range is referred to as the pebble fraction and the -5 to +10 size range is the granule fraction, conforming to the Wentworth scale size class divisions. Cobbles (>64 mm) are not present in the samples. Six clast counts were completed on samples which displayed gold INAA values in excess of 20 ppb, or had the highest gold values at their location. A complete clast count by lithology and size class is presented in Table 1.

Trench and Creek Sections

Proportions of major clast types are shown in Figure 5. In sample KWI03-15-5B, about 75% of pebbles and granules are black chert, with minor (<5%) light grey chert, tan chert, cherty wacke, and wacke pebbles. Granitoid granules comprise 6% of the sample (Figure 5a).

Sample KWI03-15-4E pebbles and granules are about 0% black chert, 10% quartzite with minor limestone, wacke and granitoid granules (Figure 5b).

Sample KWI03-15-4D pebbles are about 60% light grey chert; 30% felsic volcanic, and 10% wacke. Granules are 45% wacke, 40% light grey chert, and 15% metawacke. The sample contains no granitoid pebbles or granules (Figure 5c).

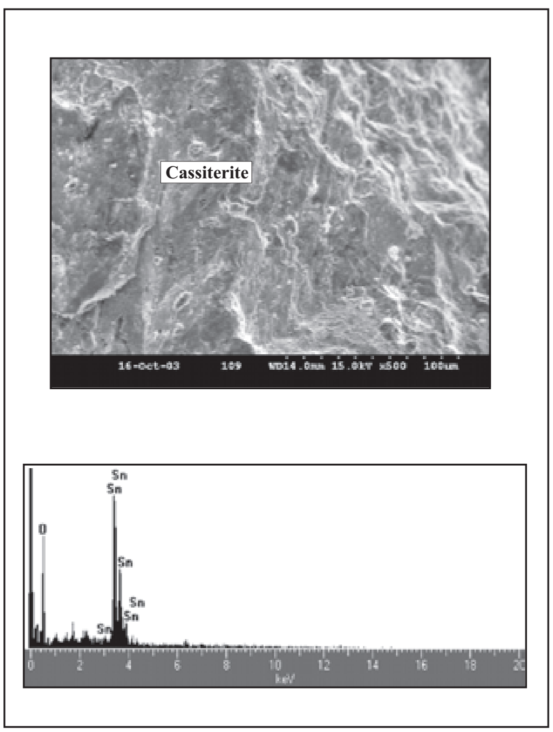

Figure 6a. SEM photomicrograph of tin-oxide (cassiterite) and EDS spectrum. The cassiterite is attached to a Feather Creek coarse crystalline crystalline gold nugget (Sample PSA03-1-1).

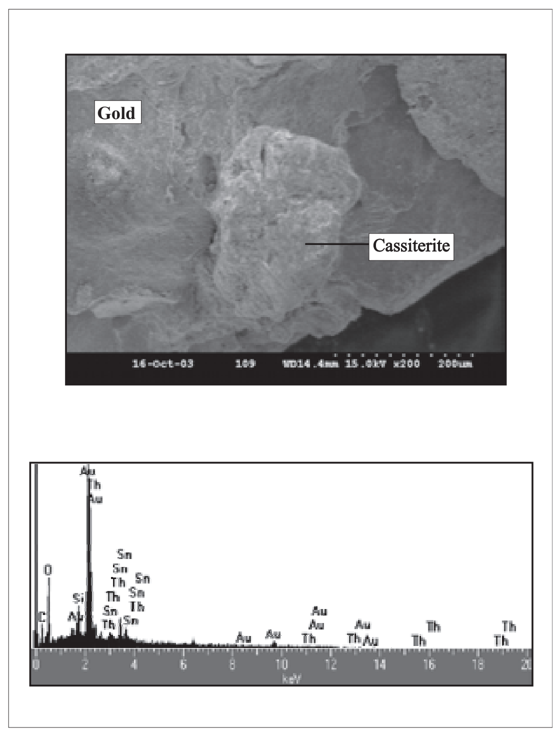

Figure 6b. SEM photomicrograph and EDS spectrum of tin-oxide (cassiterite), with thorium (thorite) on a Feather Creek gold nugget (Sample PSA03-1-4).

TABLE 3. INSTUMENTAL NEUTRON ACTIVATION ANALYSIS (INAA) FOR FEATHER CREEK PLACER GRAVELS

Sample Number/ Location	Element	Au	As	Ba	Br	Ca	Co	Cr	Cs	Fe	Hf	Na	Rb	Sb	Sc	Ta	Th	U	W	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Mass
	Units	ppb	ppm	ppm	ppm	%	ppm	ppm	ppm	%	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	g
	Detect Limit	2	0.5	50	0.5	1	1	5	1	0.02	1	0.01	15	0.1	0.1	0.5	0.5	0.5	1	0.1	3	5	0.1	0.2	0.5	0.2	0.05	0.1
	Grain Size																											
MMI03 - 24 - 2A	>2mm	5	9	1700	-0.5	-1	14	105	2	4.03	2	1.55	23	1.2	17	-0.5	1.8	-0.5	-1	7.7	18	8	2.1	0.5	-0.5	1.5	0.25	30.24
600847 mE +/- 4m	1 - 2mm	-2	10.7	2300	-0.5	-1	12	144	4	3.46	3	1.27	53	1.2	14.8	-0.5	3.6	1.8	-1	13.5	30	17	2.8	0.6	-0.5	2.1	0.33	20.08
6600989 mN	.18 - 1mm	11	14.2	2100	-0.5	-1	11	184	3	3.22	3	1.35	50	1.5	13.7	1	3.8	1.5	-1	14.7	31	15	2.9	0.8	-0.5	2.2	0.33	21.42
	<.18mm	-2	12.7	1800	-0.5	-1	12	180	2	2.84	4	1.61	39	1.3	11.5	1.3	5.5	2.8	-1	19.2	39	14	3.5	1.1	-0.5	2.5	0.38	23.45
MMI03 - 24 - 2B	>2mm	7	8.2	1900	-0.5	-1	11	140	2	3.94	3	1.29	45	1.6	17.5	1.4	3	-0.5	-1	11.5	24	12	2.6	0.7	-0.5	2.1	0.31	22.75
	1 - 2mm	2	7.6	1800	-0.5	-1	11	122	2	3.76	2	1.43	40	1.6	17.1	-0.5	3	-0.5	-1	11.1	24	15	2.6	0.7	-0.5	2	0.3	28.46
	.18 - 1mm	-2	11	1700	-0.5	-1	10	154	2	3.19	2	1.36	32	1.6	14.2	-0.5	3.3	-0.5	-1	11.9	25	10	2.7	0.7	-0.5	1.8	0.28	26.56
	<.18mm	5	10.5	1800	-0.5	-1	9	170	2	2.57	4	1.55	40	1.1	10.7	-0.5	4.9	1.4	-1	17.4	35	16	3.3	1.1	0.5	2.5	0.38	28.39
MMI03 - 24 - 3	>2mm	-2	5.9	2400	-0.5	-1	4	141	3	2.09	3	0.78	52	1.2	12.2	-0.5	6.5	3	-1	19.1	38	15	3	0.6	-0.5	2.7	0.41	28.52
600925 mE +/- 12m	1 - 2mm	11	8.6	2200	-0.5	-1	9	144	2	2.89	2	1	61	1.4	11.7	-0.5	4.8	3.4	-1	15.1	29	16	2.7	0.7	-0.5	2.1	0.3	33.57
6603714 mN	.18 - 1mm	14	14.7	2300	-0.5	-1	13	380	3	4.09	3	1.01	80	2.3	13.9	-0.5	6.1	3.7	-1	20.1	40	21	3.7	1	-0.5	2.8	0.55	23.33
	<.18mm	112	18.3	2300	2.6	-1	17	175	4	5.73	5	0.97	82	4.2	16.5	-0.5	9	6.4	-1	28.1	54	26	5.5	1.7	0.8	3.8	0.56	22.46
MMI03 - 24 - 3A	>2mm	11	8.2	2600	-0.5	-1	8	147	3	2.97	3	0.98	67	1	11.7	-0.5	5	3	-1	16.3	38	13	2.9	0.7	-0.5	2.1	0.32	26.16
	1 - 2mm	7	10	2600	-0.5	-1	7	135	3	2.61	3	0.93	49	1.3	11.3	-0.5	5.4	2.4	-1	16.8	38	18	3	0.7	-0.5	2.1	0.32	20.54
	.18 - 1mm	-2	9.2	2400	-0.5	-1	7	155	2	2.4	2	0.94	61	1.3	10	-0.5	5	2.8	-1	16.6	37	14	2.8	0.7	-0.5	1.8	0.26	31.02
	<.18mm	11	14.6	2500	-0.5	-1	13	273	3	3.54	5	1.21	63	2	12.8	-0.5	6.8	3.7	-1	27.1	61	22	4.9	1.5	-0.5	3.7	0.55	20.28
	1-2mm duplicate	8	10.7	2400	-0.5	-1	8	166	2	2.55	2	0.91	51	1.3	10.6	-0.5	5.3	2.7	-1	15.7	32	15	2.8	0.5	-0.5	1.8	0.26	23.8
MMI03 - 24 - 3B	>2mm	-2	6.4	2300	-0.5	-1	5	108	2	2.06	2	1.16	44	0.8	10.8	-0.5	3.9	1.4	-1	11	26	7	2.1	0.5	-0.5	1.6	0.24	31.68
	1 - 2mm	-2	7.1	2400	-0.5	-1	6	83	2	1.99	2	0.79	54	0.9	9	0.7	4.1	-0.5	-1	12.2	26	11	2	0.4	-0.5	1.4	0.21	36.11
	.18 - 1mm	6	7.9	2600	-0.5	-1	8	166	2	2.35	2	1.04	63	1	10.4	-0.5	5.6	2.8	2	17.3	36	13	2.8	0.5	-0.5	2	0.31	27.01
	<.18mm	12	6.3	2300	-0.5	1	9	300	2	2.43	5	1.37	60	1	10.5	2.1	5.4	3.9	-1	23.2	46	23	3.8	0.9	0.5	2.8	0.42	24.62
	>2mm duplicate	-2	4.9	2200	-0.5	-1	6	158	2	1.86	2	0.65	62	0.5	9.4	-0.5	3.9	1.5	-1	12.6	25	10	2	0.4	-0.5	1.4	0.21	27.49
MMI03 - 24 - 4B	>2mm	17000	80.8	1800	-0.5	-1	47	7050	1	33	3	0.57	41	8.4	10	-0.5	2.9	-0.5	6	12.1	25	5	2.4	0.6	-0.5	1.8	0.26	20.16
600814 mE +/- 6m	1 - 2mm	5660	69.7	1400	-0.5	-1	60	8540	-1	40.8	3	0.5	-15	9.1	9.4	-0.5	2.1	-0.5	20	12.4	30	8	2.4	0.6	-0.5	1.9	0.31	20.67
6600242 mN	.18 - 1mm	90	12.6	1700	-0.5	-1	41	7420	2	30	5	0.71	-15	2	9.2	-0.5	5.5	2.1	-1	15.7	34	12	2.8	1	0.8	2.1	0.32	19.85
	<.18mm	12700	9.3	2300	-0.5	-1	24	2930	2	17.3	8	1.19	44	1.6	11.5	2.1	5.9	-0.5	7	25.7	52	24	4.4	1.2	-0.5	3.2	0.5	12.5
	GSB 99 standard	28	60	1100	2.7	-1	42	399	-1	8.26	4	2	52	15.1	29.9	-0.5	6.4	-0.5	-1	30.3	54	30	6.4	2.5	-0.5	3.1	0.47	17.85
	STD-4 standard	4	15.8	2800	12.5	2	14	91	3	4.35	6	2.16	41	7.1	13.5	-0.5	4.3	4.2	-1	22.8	46	22	4.6	1.3	-0.5	3.5	0.54	18.42
KWI03 - 15 - 4	>2mm	-2	6.3	2100	-0.5	1	10	139	2	2.47	2	0.68	34	0.7	10.4	-0.5	2.4	-0.5	-1	9.1	19	9	2	0.4	-0.5	1.3	0.19	43.21
660858 mE +/- 14m	1 - 2mm	-2	8.7	2700	-0.5	-1	7	152	2	2.14	2	0.85	53	0.9	9	-0.5	4.2	-0.5	3	14.2	30	11	2.4	0.5	-0.5	1.6	0.26	21.68
6600903	.18 - 1mm	11	14	3300	-0.5	-1	10	322	3	3.13	3	1.05	53	1.4	11.3	-0.5	5	1.8	-1	16.5	34	14	3	0.8	-0.5	2.1	0.31	9.72
KWI03 - 15 - 4A	>2mm	-2	7	2300	-0.5	-1	7	120	2	2.41	2	0.99	47	0.6	9.7	-0.5	3.5	1.2	-1	11.5	27	11	3.2	0.6	-0.5	1.6	0.25	29.26
	1 - 2mm	-2	6.7	2400	-0.5	-1	6	102	2	2.09	2	0.82	47	0.9	8.6	-0.5	3.4	1.2	-1	12	25	8	2.2	0.6	-0.5	1.7	0.26	34.17
	.18 - 1mm	-2	7.7	2600	-0.5	-1	7	159	2	2.32	2	0.96	46	1.1	9.4	-0.5	4	1.9	-1	13.7	31	10	2.8	0.4	-0.5	1.7	0.26	27.87
	<.18mm	10	8.4	2800	2.3	-1	9	331	3	3.01	4	1.21	42	1.2	11.6	-0.5	5.9	2.2	-1	21.6	51	20	3.9	1	-0.5	2.8	0.42	20.12
KWI03 - 15 - 4B	>2mm	5	8.9	2400	-0.5	-1	8	171	1	2.19	2	0.73	44	1.2	9.4	-0.5	3.9	1.2	-1	11.2	26	11	2.4	-0.2	-0.5	1.7	0.28	20.45
	1 - 2mm	5	8.5	2400	-0.5	-1	10	131	2	2.54	3	0.99	42	1.1	10.3	1.3	4.3	1.1	-1	15.8	36	16	3.3	0.5	-0.5	2	0.3	25.17
	.18 - 1mm	2	8.8	2700	1.3	-1	9	148	2	2.61	3	1.13	55	1.1	10.6	-0.5	5.2	1.9	-1	16.6	38	14	3.3	0.6	-0.5	2.2	0.36	20.9
	<.18mm	5	8.6	2200	1.2	-1	9	235	2	2.72	4	1.17	54	1.1	11	-0.5	5	2	2	20.4	43	18	4	0.9	-0.5	2.8	0.41	27.96
	.18-1mm duplicate	10	8.4	2500	-0.5	-1	8	141	2	2.54	3	1.11	49	1	10.1	-0.5	4.6	2.1	-1	16.2	39	15	3.3	0.7	-0.5	2.3	0.36	20.34
KWI03 - 15 - 4C	>2mm	-2	6.2	1500	0.8	-1	7	255	1	2.47	2	0.49	24	0.5	9.5	-0.5	3.1	0.8	-1	7.7	16	7	1.9	0.4	-0.5	1.3	0.2	24.71
	1 - 2mm	4	13	2100	1.3	1	7	87	2	2.99	2	0.82	58	1	8.6	-0.5	3.8	1.6	-1	11.8	28	10	2.4	0.4	-0.5	1.7	0.25	32.76
	.18 - 1mm	6	17.7	2300	1.3	-1	8	143	2	3.44	3	0.96	33	1.2	9.1	-0.5	4.5	1.5	-1	14.3	32	10	2.8	0.5	-0.5	1.9	0.28	26.83
	<.18mm	7	44	2400	4.2	-1	21	195	2	7.02	4	1.02	49	1.6	11.2	1.1	7.7	2.8	-1	21.9	48	17	4.5	1.1	-0.5	2.9	0.41	24.35
	>2mm duplicate	-2	10.7	2000	0.8	-1	8	288	1	2.62	2	0.91	40	0.5	8.5	-0.5	3.3	1	-1	10.5	21	10	2.5	0.4	-0.5	1.4	0.21	16.32
KWI03 - 15 - 4D	>2mm	4	7.8	2000	-0.5	-1	8	192	2	2.1	2	0.66	42	0.9	8.8	-0.5	3.4	1.6	-1	10.3	22	11	2.4	0.7	-0.5	1.5	0.23	20.49
	1 - 2mm	10	6.1	2600	1.6	-1	8	220	2	2.15	3	1.01	50	0.9	11.5	-0.5	5.6	1.4	-1	18.7	38	15	3.3	0.6	-0.5	2.2	0.34	22.82
	.18 - 1mm	17	5	2400	1.4	-1	7	219	3	1.85	3	1.06	53	1	10	-0.5	5.1	2	-1	17.9	35	14	3	0.6	-0.5	2.1	0.32	32.2
	<.18mm	85	4.3	2300	-0.5	-1	9	216	3	2.23	4	1.2	44	0.8	11.7	-0.5	5.9	1.5	-1	23.1	46	19	4	1.1	-0.5	2.9	0.42	26.32
KWI03 - 15 - 4E	>2mm	4	7.5	1600	-0.5	4	6	135	-1	1.96	2	0.69	38	0.6	8.4	-0.5	2.9	1.3	-1	9	21	10	1.9	0.4	-0.5	1.4	0.22	27.56
	1 - 2mm	5	8.3	1700	-0.5	4	8	125	2	2.21	2	0.76	43	1	9.1	1.1	4	1.1	-1	12	24	11	2.4	0.5	-0.5	1.7	0.26	25.2
	.18 - 1mm	10	11.5	2000	-0.5	4	11	163	2	2.78	3	0.97	38	1.6	11.2	-0.5	4.8	2.4	-1	16.2	32	13	3	0.8	-0.5	2.4	0.35	24.83
	<.18mm	24	10.7	2000	-0.5	3	13	122	3	3.03	3	1.06	54	1.6	12.2	-0.5	5.2	1.9	-1	17.2	37	15	3.4	0.9	-0.5	2.4	0.36	28.21

	Element	Au	As	Ba	Br	Ca	Co	Cr	Cs	Fe	Hf	Na	Rb	Sb	Sc	Ta	Th	U	W	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu	Mass
	Units	ppb	ppm	ppm	ppm	%	ppm	ppm	ppm	%	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	g
	Detect Limit	2	0.5	50	0.5	1	1	5	1	0.02	1	0.01	15	0.1	0.1	0.5	0.5	0.5	1	0.1	3	5	0.1	0.2	0.5	0.2	0.05	0.1
KWI03 - 15 - 5A	>2mm	7	6.2	2300	-0.5	-1	8	104	2	2.33	2	0.95	32	0.8	9.7	-0.5	3.5	1.5	-1	12.3	25	11	2.3	0.5	-0.5	1.6	0.24	32.19
600415 mE +/- 6m	1 - 2mm	8	8.8	2300	0.8	-1	7	100	3	2.44	2	0.79	57	1.5	9.9	0.9	4.4	1.5	-1	15.5	33	12	2.6	0.5	-0.5	1.9	0.29	32.25
6600471 mN	.18 - 1mm	10	10.1	2500	-0.5	2	8	165	2	2.75	3	1.01	52	1.5	10.1	-0.5	5.3	1.8	2	17.8	33	14	2.9	0.6	-0.5	1.8	0.26	28.8
	<.18mm	6	7.4	2100	-0.5	-1	8	145	2	2.27	4	1.24	34	1.2	9.9	2.1	6.2	1.5	-1	22.6	48	18	3.7	1	-0.5	2.3	0.35	27.91
KWI03 - 15 - 5B	>2mm	-2	5.9	1800	-0.5	3	8	213	1	2.31	2	0.67	37	0.7	10.2	-0.5	3.1	1.3	-1	9.8	21	10	1.9	0.4	-0.5	1.4	0.21	29.38
	1 - 2mm	7	7.3	1800	-0.5	4	11	162	2	2.7	2	0.96	45	1	11	-0.5	4	1.9	-1	14.5	29	13	2.6	0.8	-0.5	1.8	0.26	30.06
	.18 - 1mm	4	8.4	1900	-0.5	3	14	152	3	3.13	3	1.1	50	1.1	12.6	-0.5	4.9	1.6	-1	17.3	34	16	3.3	0.6	0.6	2.1	0.31	28.19
	<.18mm	7	12.1	2100	-0.5	3	18	185	2	3.89	4	1.3	85	1.5	15.2	-0.5	6.8	2.1	-1	22.1	44	15	4	1.1	-0.5	2.8	0.42	16.3
KWI03 - 15 - 5C	>2mm	-2	7.7	1600	-0.5	4	5	128	1	1.78	1	0.44	33	0.6	6.5	-0.5	2.3	1.2	-1	7.7	17	-5	2.3	0.4	-0.5	1.1	0.17	24.82
	1 - 2mm	-2	12.2	1800	-0.5	-1	11	143	2	3.1	3	1.03	36	1.1	12.7	-0.5	4.6	1.2	-1	15.9	36	16	3.3	0.8	-0.5	2.4	0.36	27.92
	.18 - 1mm	-2	15.5	2400	-0.5	1	15	171	3	3.84	4	1.19	63	1.5	15.5	-0.5	6.3	1.3	-1	19.9	43	19	3.8	0.9	-0.5	2.6	0.39	20.94
	<.18mm	9	14.5	2000	1.5	-1	16	172	3	3.62	4	1.18	56	1.7	14.3	-0.5	6.1	1.6	-1	20.9	43	14	3	1.1	0.6	2.6	0.4	24.3
	GSB 99 standard	32	62.6	1100	-0.5	-1	43	378	2	8	4	1.96	45	14.7	30.1	2.3	6.2	-0.5	-1	30.2	68	21	6.2	2.2	-0.5	2.8	0.42	20.52
Q/C																												
KWI03 - 15 - 4	1 - 2mm	7	10	2600	-0.5	-1	7	135	3	2.61	3	0.93	49	1.3	11.3	-0.5	5.4	2.4	-1	16.8	38	18	3	0.7	-0.5	2.1	0.32	20.54
	1 - 2mm duplicate	8	10.7	2400	-0.5	-1	8	166	2	2.55	2	0.91	51	1.3	10.6	-0.5	5.3	2.7	-1	15.7	32	15	2.8	0.5	-0.5	1.8	0.26	23.8
	% difference	13.3	6.8	8.0	0.0	0.0	13.3	20.6	40.0	2.3	40.0	2.2	4.0	0.0	6.4	0.0	1.9	11.8	0.0	6.8	17.1	18.2	6.9	33.3	0.0	15.4	20.7	14.7
MMI03 - 24 - 3B	>2mm	-2	6.4	2300	-0.5	-1	5	108	2	2.06	2	1.16	44	0.8	10.8	-0.5	3.9	1.4	-1	11	26	7	2.1	0.5	-0.5	1.6	0.24	31.68
	>2mm duplicate	-2	4.9	2200	-0.5	-1	6	158	2	1.86	2	0.65	62	0.5	9.4	-0.5	3.9	1.5	-1	12.6	25	10	2	0.4	-0.5	1.4	0.21	27.49
	% difference	0.0	26.5	4.4	0.0	0.0	18.2	37.6	0.0	10.2	0.0	56.4	34.0	46.2	13.9	0.0	0.0	6.9	0.0	13.6	3.9	35.3	4.9	22.2	0.0	13.3	13.3	14.2
KWI03 - 15 - 4B	.18 - 1mm	2	8.8	2700	1.3	-1	9	148	2	2.61	3	1.13	55	1.1	10.6	-0.5	5.2	1.9	-1	16.6	38	14	3.3	0.6	-0.5	2.2	0.36	20.9
	.18 - 1mm duplicate	10	8.4	2500	-0.5	-1	8	141	2	2.54	3	1.11	49	1	10.1	-0.5	4.6	2.1	-1	16.2	39	15	3.3	0.7	-0.5	2.3	0.36	20.34
	% difference	133.3	4.7	7.7	450.0	0.0	11.8	4.8	0.0	2.7	0.0	1.8	11.5	9.5	4.8	0.0	12.2	10.0	0.0	2.4	2.6	6.9	0.0	15.4	0.0	4.4	0.0	2.7
Standards	STD-4 standard	4	15.8	2800	12.5	2	14	91	3	4.35	6	2.16	41	7.1	13.5	-0.5	4.3	4.2	-1	22.8	46	22	4.6	1.3	-0.5	3.5	0.54	18.42
	CANMET Ref. values*	4	15	2000	13		13	93	1.9	4.1	5.5		39	7.3	14	0.6	4.3	3	-4	24	44	21	5	1.2	0.8	2.6	0.5	
	% difference	0.0	5.2	33.3	3.9		7.4	2.2	44.9	5.9	8.7		5.0	2.8	3.6	2200	0.0	33.3	-120	5.1	4.4	4.7	8.3	8.0	867	29.5	7.7	200.0

Notes:
Prep. Sediment samples prepared @ GSB, Victoria.
INA - Instrumental neutron activation analysis
ACT - ActLabs, Ancaster, Ontario.
% Difference = ABS ((x1-x2)/(x1+x2)/2)x100
BAL = Balance
* CANMET Reference value (Bowman, 1994)

Elements Ag, Hg,Ir, Mo, Ni, Se, Sn, Sr, Zn were included in analysis, but results were either below detection or unreliable.

TABLE 4. INDUCTIVELY COUPLED PLASMA EMISSION SPECTRSOSCOPY (ICPES) FOR FEATHER CREEK PLACER GRAVELS.

	Element	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P	La	Cr	Mg	Ba	Al	Na	K	W	Sc	S	Hg	Se	Te	Ga
	Units	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%	ppm	ppm	%	ppm	%	%	%	ppm	ppm	%	ppb	ppm	ppm	ppm
	Detect Limit	0.01	0.01	0.01	0.1	2	0.1	0.1	1	0.01	0.1	0.1	1	0.1	0.5	0.01	0.02	0.02	2	0.01	0	0.5	0.5	0.01	0.5	0.01	0.001	0.01	0.2		0.02	5	0.1	0.02	0.02
Sample Number	Grain Size	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%	ppm	ppm	%	ppm	%	%	%	ppm	ppm	%	ppb	ppm	ppm	ppm
MMI03 - 24 - 2A	>2mm	0.78	64.3	2.84	70.1	57	29.6	14.4	631	3.67	8.6	0.2	1.7	1.1	14.6	0.2	0.53	0.05	47	0.23	0.05	4.7	59.6	1.41	196	2	0.015	0.07	< .1	4	< .01	21	0.1	0.02	5.3
	1 - 2mm	1.56	48.8	4.31	58.6	109	27.7	9.4	762	2.47	8	0.4	1.6	2	17.8	0.23	0.57	0.1	32	0.25	0.05	7.9	50	0.81	164	1.2	0.011	0.07	< .1	2.8	0.02	30	0.2	0.03	3.6
	.18 - 1mm	1.84	55	5.47	63.9	113	30.7	11.2	830	2.59	9.9	0.5	1.9	2.4	20.9	0.29	0.7	0.13	37	0.28	0.05	9.4	76.8	0.76	230	1.28	0.02	0.12	< .1	3.5	0.01	33	0.3	0.05	3.8
	<.18mm	1.95	57.5	6.82	62.1	111	31.5	11.6	835	2.26	10	0.5	3.5	2.9	23.2	0.27	0.73	0.15	34	0.33	0.06	11.4	57.8	0.53	191	1.03	0.018	0.08	< .1	3.4	0.02	49	0.2	0.06	3.1
MMI03 - 24 - 2B	>2mm	2.19	71.8	4.88	73.2	53	31	11.8	624	3.27	6.3	0.4	0.8	2.1	15.7	0.18	0.61	0.17	43	0.25	0.04	7.8	73.8	1.31	202	1.94	0.018	0.13	< .1	3.8	0.01	15	0.2	0.08	5.2
	1 - 2mm	0.91	54.9	3.57	66.9	64	28.6	11.8	688	3.06	6.7	0.3	1.9	1.7	14.5	0.19	0.61	0.1	43	0.27	0.05	6.7	51.7	1.19	134	1.69	0.01	0.06	< .1	3.7	0.01	19	0.2	0.06	4.7
	.18 - 1mm	1.17	55.6	4.45	63	95	29.2	11	748	2.83	7.4	0.4	2.1	2.1	18.7	0.2	0.73	0.11	44	0.28	0.05	8.1	75.3	1.01	207	1.55	0.021	0.1	< .1	4	0.02	27	0.2	0.04	4.3
	<.18mm	1.65	49.7	4.93	51.9	117	27	9.2	540	2.04	8.4	0.5	3	2.7	19.9	0.22	0.69	0.12	33	0.28	0.05	10.2	47	0.48	164	0.91	0.012	0.06	< .1	3	0.04	37	0.3	0.05	2.9
MMI03 - 24 - 3	>2mm	3.36	31.5	3.5	47.4	90	14.8	4.4	264	1.6	3	0.9	< .2	5.3	11.9	0.17	0.44	0.09	24	0.12	0.02	15.9	60.5	0.58	221	0.87	0.011	0.16	< .1	1.8	0.03	33	0.3	< .02	2.9
	1 - 2mm	4.83	48.5	5.71	69	99	26.2	8.3	402	2.4	6.4	1.2	1.4	3.5	20.1	0.32	0.77	0.19	30	0.31	0.04	11.9	71.1	0.53	218	0.96	0.02	0.14	< .1	2.3	0.02	34	0.8	0.08	3.2
	.18 - 1mm	7.53	69.3	8.09	93.4	146	31.8	10.7	482	3.06	9.5	1.6	6.2	4.3	22.2	0.37	1.24	0.3	40	0.29	0.05	14.3	87.9	0.61	224	1.09	0.017	0.16	< .1	2.6	0.03	58	1.2	0.08	3.6
	<.18mm	21.3	128	18.5	139	480	44.9	16.5	726	4.68	13.6	3.8	51.7	6.5	26.4	0.66	2.64	0.62	44	0.28	0.07	21.5	54.1	0.63	225	1.31	0.009	0.14	< .1	3.8	0.04	213	4.5	0.36	4
	ACME Q/C	21.7	131	19	143	491	46.7	16.5	743	4.8	14.1	3.8	48.6	6.5	27	0.69	2.67	0.65	44	0.29	0.08	22.1	55.1	0.65	231	1.33	0.01	0.15	0.1	3.7	0.04	232	4.7	0.4	4
MMI03 - 24 - 3A	>2mm	3.81	47.1	5.43	68.8	104	36.5	7.9	378	2.51	5.7	0.9	0.6	3.3	16.9	0.38	0.53	0.13	41	0.23	0.05	12.4	76.3	0.55	372	1.03	0.024	0.19	0.1	3.1	0.07	33	0.4	0.03	3.8
	1 - 2mm	5.57	53.9	6.05	76.3	122	36.3	7.1	690	2.15	6.6	1.1	0.9	3.7	18.1	0.64	0.68	0.3	27	0.23	0.04	12.5	60.4	0.45	221	0.87	0.013	0.12	< .1	2.2	0.03	42	0.4	0.07	2.8
	.18 - 1mm	5.16	55.4	6.43	83.1	135	38.3	7.4	682	2.08	7.3	1.1	2.5	3.5	15.4	0.68	0.73	0.19	26	0.2	0.05	12	40.5	0.43	161	0.78	0.008	0.08	< .1	2.1	0.01	55	0.4	0.07	2.7
	<.18mm	10.9	101	11.2	129	256	87.1	12.2	2087	2.77	10	2	5.7	4.4	22	2.45	1.03	0.3	40	0.29	0.08	17.5	65.5	0.51	295	1.1	0.012	0.12	0.4	3.6	0.01	147	0.5	0.1	3.6
	1-2mm duplicate	4.85	53.6	5.79	79.3	109	37.3	7.7	739	2.29	8.2	1.1	0.5	3.6	22.8	0.68	0.7	0.17	32	0.27	0.06	12.6	94.9	0.47	307	1	0.02	0.18	< .1	2.5	0.02	53	0.4	0.08	3.3
MMI03 - 24 - 3B	>2mm	1.2	28.3	4.8	58.1	28	22.4	5.6	319	1.79	4.9	0.4	0.2	2.8	61	0.26	0.3	0.12	31	0.22	0.04	8.8	53.3	0.55	292	0.97	0.014	0.09	< .1	2.4	0.02	12	0.2	0.03	3.2
	1 - 2mm	3.13	38.8	5.28	73.1	34	25.1	6.2	348	1.79	6	0.7	1.7	2.9	11	0.35	0.51	0.16	22	0.14	0.04	10.2	41.6	0.39	148	0.81	0.008	0.09	< .1	1.7	0.02	23	0.3	0.05	2.5
	.18 - 1mm	3.18	45.3	5.92	84.5	49	29.9	7.2	321	1.96	6.4	1	2.8	3.2	13.5	0.34	0.59	0.2	26	0.15	0.04	12.7	72.3	0.42	210	0.95	0.012	0.12	< .1	2.1	0.02	21	0.4	0.06	3.1
	<.18mm	2.58	45.8	6.04	86.7	79	32.5	8.1	317	1.8	5.1	1.5	3.4	3.2	18.7	0.42	0.53	0.24	34	0.24	0.06	14.7	97.5	0.43	234	1.02	0.022	0.13	0.2	2.7	0.03	47	0.2	0.05	3.3
	>2mm duplicate	1.62	29.7	4.33	60.7	30	27.7	6.1	405	1.58	3.8	0.5	0.3	2.6	8.1	0.17	0.26	0.24	28	0.08	0.03	9	91.6	0.42	234	0.79	0.018	0.16	< .1	2.5	0.02	6	0.1	0.05	2.6
MMI03 - 24 - 4B	>2mm	17.6	197	16.5	92.5	1636	159	34.3	3638	24.7	70.7	1.5	22780	2.6	21.3	1.16	7.15	1.47	399	0.34	0.05	11.8	559	0.51	765	0.77	0.014	0.08	0.9	2.6	< .01	180	5.1	1.53	8
	1 - 2mm	27.3	326	15.6	84.5	411	236	40.8	3645	32.1	58.4	1.4	91.3	2.5	17.4	0.63	8.82	0.79	464	0.3	0.05	12	649	0.49	803	0.74	0.011	0.07	2.8	2.4	< .01	96	2.3	0.75	9.7
	.18 - 1mm	5.19	46.3	6.72	70.5	76	95.1	21.3	951	18.7	8.2	0.8	14.8	2.8	13.7	0.34	1.22	0.22	460	0.31	0.05	11.7	410	0.36	216	0.61	0.01	0.06	0.2	1.8	< .01	35	0.2	0.04	7.1
	<.18mm	4.86	38.8	7.52	78.9	1493	65.3	16	1047	13	6.7	1.1	14140	4	23.3	0.41	0.92	0.26	352	0.43	0.05	17.6	331	0.43	366	0.93	0.035	0.13	1.5	2.7	< .01	1022	0.2	0.03	7.5
	GSB 99 standard	0.94	159	221	330	1351	195	42	1331	6.6	55.1	0.5	21	3.8	16.7	0.66	9.16	0.25	97	0.34	0.1	16.7	251	2.55	337	2.82	0.005	0.04	< .1	14.9	< .01	327	0.5	0.22	9.1
	STDS-4 standard	1.36	64.4	14.6	84.4	306	23.7	10	1185	2.59	11.7	2	2.7	1.5	58.4	0.37	5.02	0.21	49	1.07	0.08	13.4	31	0.65	1009	1.06	0.033	0.09	0.2	3.1	0.12	817	0.8	0.02	3.7
KWI03 - 15 - 4	>2mm	1.37	37.1	3.03	48.4	91	31.4	9.6	390	1.99	6.5	0.3	0.9	1.5	18.6	0.71	0.3	0.12	30	0.49	0.04	5.8	65.7	0.55	260	0.84	0.013	0.07	< .1	2.7	0.07	19	0.3	0.04	3
	1 - 2mm	2.53	33.3	4.32	53.8	59	27.1	6.7	581	1.76	6.8	0.5	1	3	25.6	0.39	0.5	0.17	25	0.97	0.04	11.9	80.9	0.45	264	0.78	0.016	0.13	< .1	2.2	0.05	30	0.3	0.04	2.9
	.18 - 1mm	2.35	37.9	5.22	57.9	75	33.9	8	873	2.09	7.7	0.6	1.2	2.8	33.3	0.48	0.52	0.14	34	1.33	0.04	10.8	162	0.54	489	1.13	0.042	0.25	< .1	3.2	0.03	39	0.3	0.05	4
	<.18mm	3.54	52	8.78	71.2	115	52.9	10.9	1860	2.54	10.5	0.7	4.7	3.1	48.6	0.97	0.77	0.16	42	2.48	0.05	12.6	180	0.66	566	1.25	0.046	0.24	0.1	4	0.03	64	0.4	0.05	4.4
KWI03 - 15 - 4A	>2mm	1.61	31.3	4.22	61.4	51	24.5	7.1	426	2.07	5.7	0.4	0.8	2.1	13.6	0.23	0.36	0.12	26	0.23	0.04	8.7	60.9	0.54	170	0.86	0.014	0.12	< .1	2.5	0.02	11	0.2	0.09	3.4
	ACME Q/C	12.4	135	25	132	260	22.8	11.6	737	2.88	17.5	6.2	40.8	2.8	46.6	5.17	3.52	5.68	57	0.71	0.09	11	179	0.64	135	2.01	0.032	0.13	4.2	3.4	0.05	170	4.8	0.82	6.5
	1 - 2mm	1.95	33.9	4.42	56.4	62	26.8	7	456	1.74	6.6	0.4	1.4	2.4	14.8	0.32	0.48	0.11	21	0.22	0.04	9.3	49.8	0.41	152	0.71	0.011	0.1	< .1	1.9	< .01	24	0.2	0.04	2.4
	.18 - 1mm	2.06	36.1	4.76	63	76	27.5	7.2	419	1.86	6.8	0.4	2	2.6	15.1	0.28	0.5	0.14	26	0.25	0.04	10.3	76.6	0.43	185	0.83	0.016	0.14	< .1	2.3	< .01	30	0.2	0.04	2.8
	<.18mm	2.26	44.3	5.96	81	163	34.1	8.8	549	2.22	7.7	0.5	2.3	3.2	21.5	0.36	0.59	0.18	38	0.39	0.06	14	106	0.55	243	1.17	0.028	0.21	< .1	3.6	< .01	52	0.3	0.06	3.7
KWI03 - 15 - 4B	>2mm	1.53	31.1	4.46	49.1	41	26.1	6.4	583	1.61	7.4	0.4	1.2	2.2	14.1	0.32	0.51	0.11	22	0.2	0.04	8.1	84.9	0.36	204	0.65	0.013	0.12	< .1	2	< .01	22	0.2	0.03	2.2
	1 - 2mm	2.78	46.2	5.9	79.5	91	36.6	10.3	883	2.05	8.2	0.5	1.9	3	15	0.49	0.6	0.18	29	0.28	0.04	11.8	57.1	0.49	200	0.9	0.011	0.12	< .1	2.7	< .01	31	0.3	0.04	3
	.18 - 1mm	2.36	37.9	5.04	67.9	71	29.3	8.2	515	1.82	6.8	0.5	1.5	2.7	13.4	0.31	0.53	0.17	25	0.24	0.04	10.7	50.6	0.43	157	0.76	0.011	0.1	< .1	2.2	< .01	40	0.2	0.04	2.6
	<.18mm	2.14	41.9	5.5	76.3	107	31.8	8.5	527	1.99	7.2	0.5	3.3	2.6	16.7	0.31	0.56	0.2	31	0.32	0.05	12.3	61.5	0.47	181	0.87	0.014	0.12	< .1	2.8	< .01	42	0.3	0.03	2.9
KWI03 - 15 - 4C	>2mm	1.21	26.5	2.58	33.9	36	21.3	6.5	557	1.73	5.8	0.3	0.3	1.8	11.8	0.18	0.28	0.06	29	0.32	0.02	5.7	158	0.42	292	0.71	0.036	0.14	< .1	2.6	< .01	11	0.2	< .02	2.4
	1 - 2mm	3.14	34	3.95	53.4	48	25.9	7.1	658	2.47	13.1	0.5	1.4	2.5	13.1	0.4	0.55	0.11	22	0.21	0.04	8.8	44.2	0.37	151	0.65	0.01	0.09	< .1	1.8	< .01	21	0.2	0.04	2.2
	.18 - 1mm	4.01	38.6	4.47	61.1	64	31.5	8.6	709	2.94	17.1	0.5	2.1	3	14.3	0.5	0.66	0.13	26	0.25	0.04	10.8	63.6	0.4	199	0.73	0.013	0.11	< .1	2.2	< .01	40	0.3	0.03	2.6
	<.18mm	11.9	82	8.98	109	165	92.6	22.8	4896	6.48	44.2	1.2	4.8	4.7	20.1	3.3	1.33	0.22	51	0.47	0.07	16.7	65.6	0.61	535	1.2	0.016	0.17	0.1	4.1	< .01	82	0.5	0.08	4.4
KWI03 - 15 - 4D	>2mm	0.95	33.5	3.82	42.8	58	19.4	6.1	298	1.63	6.3	0.4	0.4	2	13.5	0.22	0.35	0.11	28	0.24	0.03	7.7	99.7	0.41	209	0.75	0.017	0.13	< .1	2.2	0.02	11	0.2	0.04	2.8
	1 - 2mm	1	39.3	5.98	87.2	108	29.4	8.2	201	1.7	4.1	0.4	3	3.1	19	0.14	0.39	0.2	31	0.33	0.04	13.1	110	0.53	274	1.21	0.025	0.18	< .1	3.3	< .01	39	0.2	0.03	3.7
	.18 - 1mm	1.02	35.5	5.77	87.6	112	29	7.4	170	1.55	2.9	0.4	18.4	3.2	18	0.14	0.35	0.21	29	0.3	0.04	13.7	104	0.52	243	1.1	0.023	0.16	< .1	2.9	0.01	29	0.1	0.03	3.5
	<.18mm	0.93	41.8	6.6	107	119	34	8.4	175	1.62	3.2	0.5	2	3.4	18.9	0.17	0.39	0.25	31	0.36	0.05	14.4	72.8	0.55	207	1.15	0.017	0.12	< .1	3.3	< .01	42	0.1	0.05	3.6
	ACME Q/C	0.95	40.1	6.21	102	112	32.3	7.7	173	1.59	2.8	0.4	5.6	3.2	18.3	0.15	0.38	0.24	29	0.35	0.05	13.5	69.7	0.54	195	1.11	0.016	0.11	0.1	3.2	0.01	42	0.1	0.04	3.4
	<.18mm duplicate	0.92	40.2	6.15	103	116	32.5	7.9	169	1.58	2.9	0.4	7.8	3.2	18	0.15	0.36	0.24	29	0.35	0.04	13.2	68.8	0.54	194	1.1	0.015	0.11	0.1	3.1	< .01	43	0.1	0.03	3.4

KWI03 - 15 - 4E	>2mm	1.63	29	3.66	38.9	60	14	5.3	280	1.43	5.6	0.6	< .2	1.7	81.9	0.18	0.37	0.07	28	3.61	0.04	6.6	62.6	0.58	166	0.75	0.037	0.1	< .1	2.2	0.02	22	0.3	0.02	2.5
	1 - 2mm	1.76	35.7	5.71	52.5	92	30.5	7.7	402	1.78	6.2	0.7	0.3	2.5	61.8	0.32	0.6	0.11	31	3.84	0.05	9.1	63.1	0.7	188	0.85	0.015	0.14	< .1	3	0.03	59	0.5	0.04	3.1
	.18 - 1mm	2.23	52.6	7.32	72.6	124	45.8	11.1	601	2.31	8.5	0.9	0.7	3.6	62.9	0.48	0.79	0.16	45	3.9	0.06	13.3	82.3	0.81	297	1.37	0.024	0.23	< .1	4.5	0.01	87	0.6	0.06	4.5
	<.18mm	2.39	57.8	8.04	75.8	148	50.2	12.3	729	2.39	8.9	0.8	0.5	3.6	62	0.56	0.79	0.17	43	3.97	0.07	13.5	52.8	0.83	269	1.29	0.016	0.18	< .1	4.6	0.01	102	0.7	0.05	4.2
KWI03 - 15 - 5A	>2mm	2.45	39.5	5.02	54.2	49	21.2	6.8	383	1.95	4.5	0.6	1	2.3	23.6	0.17	0.44	0.12	34	0.31	0.04	9	52.9	0.43	237	0.89	0.019	0.1	< .1	2.6	0.02	32	0.3	< .02	3.3
	1 - 2mm	2.95	48.4	6.88	57.1	50	26.2	7.7	620	2.13	8.5	0.7	4.5	3.3	14.3	0.19	0.73	0.18	27	0.16	0.04	13.2	48.3	0.37	220	0.86	0.008	0.08	< .1	2.3	< .01	27	0.5	0.05	3
	.18 - 1mm	3.58	50.1	6.95	57.2	60	27.7	8.1	676	2.24	7.6	0.8	3.4	3.3	15.7	0.2	0.84	0.25	30	0.17	0.04	13.8	85.5	0.39	288	1.05	0.018	0.13	< .1	2.7	< .01	31	0.5	0.06	3.3
	<.18mm	1.83	36.8	5.49	45.4	41	26	7.3	457	1.7	5.5	0.7	5.1	3	15.5	0.14	0.49	0.17	32	0.21	0.04	15.5	58.6	0.41	207	0.93	0.014	0.07	< .1	2.9	< .01	31	0.3	0.03	3
KWI03 - 15 - 5B	>2mm	0.56	28.7	2.84	37.7	59	29.3	5.8	272	1.55	4.2	0.3	< .2	1.5	41.3	0.11	0.29	0.08	21	2.17	0.03	6.1	63.5	0.7	126	0.77	0.007	0.09	< .1	1.8	0.01	37	0.2	0.03	2.8
	1 - 2mm	1.43	44.4	5.53	59.6	100	54.5	11.1	516	2.16	6.3	0.6	0.7	3	50.6	0.33	0.52	0.12	42	2.9	0.06	11.6	77.7	0.92	209	1.24	0.016	0.18	< .1	4.1	< .01	79	0.3	0.04	4.1
	.18 - 1mm	1.56	54.7	6.73	71.7	124	69	13.7	623	2.46	7.1	0.7	1.1	3.6	49.2	0.35	0.63	0.15	47	2.93	0.06	13.7	68	1.03	210	1.39	0.012	0.18	< .1	5	< .01	79	0.2	0.06	4.5
	<.18mm	1.69	62.1	7.72	81	134	79.8	15.6	723	2.68	8.4	0.7	1.4	3.9	50.5	0.43	0.67	0.16	53	3.1	0.07	15.2	74.3	1.1	248	1.53	0.015	0.21	< .1	5.5	< .01	110	0.2	0.04	5.1
	<.18mm duplicate	1.7	61.3	7.69	75.1	141	77.1	15	727	2.73	7.8	0.8	1.7	4	52.7	0.44	0.64	0.15	56	3.1	0.07	15.3	99.5	1.12	299	1.67	0.026	0.26	< .1	5.7	< .01	97	0.3	0.06	5.5
KWI03 - 15 - 5C	>2mm	0.89	29.7	4.2	30.9	72	15.6	4.7	398	1.44	3.6	0.6	< .2	1.3	145	0.75	0.29	0.07	20	3.48	0.07	6.1	62.3	0.38	198	0.64	0.008	0.08	< .1	1.9	< .01	32	0.3	0.02	2.3
	1 - 2mm	1.77	52.8	6.66	65.2	103	56	11.8	572	2.46	7.5	0.5	7.8	3.3	24.4	0.28	0.64	0.17	45	0.53	0.06	12.8	70.6	0.78	199	1.37	0.014	0.13	< .1	4.1	< .01	76	0.4	0.04	4.4
	.18 - 1mm	1.97	60.5	7.29	75.7	116	66.9	14	680	2.7	8.6	0.6	2.1	3.9	24.5	0.34	0.68	0.16	50	0.57	0.06	14.2	70.8	0.88	215	1.56	0.014	0.15	< .1	4.7	< .01	91	0.3	0.06	5
	<.18mm	2	68.9	8.03	80.8	138	75.3	15.3	752	2.91	9.3	0.6	2.3	4.2	26.1	0.4	0.76	0.18	56	0.64	0.07	16	74.2	0.95	243	1.71	0.014	0.17	< .1	5.5	< .01	112	0.3	0.04	5.5
Std. DS5	ACME Q/C	13.2	141	25.2	139	294	24.8	11.8	791	2.98	19.1	6.4	40.1	3	48.5	5.69	3.8	5.85	59	0.75	0.1	11.8	190	0.68	135	2.09	0.035	0.14	4.2	3.6	0.03	172	5.1	0.89	6.7
	.18-1mm duplicate	1.79	59.7	7.22	73.8	101	64.8	13.8	634	2.62	7.5	0.6	5	3.3	24	0.33	0.67	0.16	49	0.54	0.06	14.1	72.4	0.86	206	1.52	0.013	0.15	< .1	4.9	< .01	81	0.2	0.06	4.7
	GSB 99 standard	0.84	166	206	346	1297	200	43.8	1277	6.64	51	0.5	22	3.3	17.6	0.68	8.76	0.24	100	0.35	0.1	16.3	245	2.67	277	2.91	0.006	0.04	< .1	15	< .01	326	0.4	0.3	8.4
Std. DS5	ACME Q/C	13.1	145	25.6	139	282	24.9	12.6	744	2.99	17.2	6.4	42.5	2.8	48.4	5.57	3.83	5.7	61	0.74	0.1	12.1	183	0.69	133	2.09	0.034	0.14	4.4	3.6	0.01	169	5.1	0.86	6.6
Q/C																																			
	Element	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P	La	Cr	Mg	Ba	Al	Na	K	W	Sc	S	Hg	Se	Te	Ga
MMI03 - 24 - 3A	1 - 2mm	5.57	53.9	6.05	76.3	122	36.3	7.1	690	2.15	6.6	1.1	0.9	3.7	18.1	0.64	0.68	0.3	27	0.23	0.04	12.5	60.4	0.45	221	0.87	0.013	0.12	-0.1	2.2	0.03	42	0.4	0.07	2.8
	1-2mm duplicate	4.85	53.6	5.79	79.3	109	37.3	7.7	739	2.29	8.2	1.1	0.5	3.6	22.8	0.68	0.7	0.17	32	0.27	0.06	12.6	94.9	0.47	307	1	0.02	0.18	-0.1	2.5	0.02	53	0.4	0.08	3.3
	% difference	13.8	0.6	4.39	3.86	11.3	2.72	8.11	6.86	6.31	21.6	0	57.14	2.74	23	6.06	2.9	55.3	16.9	16	26.3	0.8	44.4	4.35	32.6	13.9	42.42	40	0	12.8	40	23.2	0	13.3	16.4
MMI03 - 24 - 3B	>2mm	1.2	28.3	4.8	58.1	28	22.4	5.6	319	1.79	4.9	0.4	0.2	2.8	61	0.26	0.3	0.12	31	0.22	0.04	8.8	53.3	0.55	292	0.97	0.014	0.09	-0.1	2.4	0.02	12	0.2	0.03	3.2
	>2mm duplicate	1.62	29.7	4.33	60.7	30	27.7	6.1	405	1.58	3.8	0.5	0.3	2.6	8.1	0.17	0.26	0.24	28	0.08	0.03	9	91.6	0.42	234	0.79	0.018	0.16	-0.1	2.5	0.02	6	0.1	0.05	2.6
	% difference	29.8	4.8	10.3	4.38	6.9	21.2	8.55	23.8	12.5	25.3	22.2	40	7.41	153	41.9	14.3	66.7	10.2	93.3	14.5	2.25	52.9	26.8	22.1	20.5	25	56	0	4.08	0	66.7	66.7	50	20.7
KWI03 - 15 - 4D	<.18mm	0.93	41.8	6.6	107	119	34	8.4	175	1.62	3.2	0.5	2	3.4	18.9	0.17	0.39	0.25	31	0.36	0.05	14.4	72.8	0.55	207	1.15	0.017	0.12	-0.1	3.3	-0.01	42	0.1	0.05	3.6
	<.18mm duplicate	0.92	40.2	6.15	103	116	32.5	7.9	169	1.58	2.9	0.4	7.8	3.2	18	0.15	0.36	0.24	29	0.35	0.04	13.2	68.8	0.54	194	1.1	0.015	0.11	0.1	3.1	-0.01	43	0.1	0.03	3.4
	% difference	1.08	3.93	7.06	4.48	2.55	4.51	6.13	3.49	2.5	9.84	22.2	118.4	6.06	4.88	12.5	8	4.08	6.67	2.82	2.25	8.7	5.65	1.83	6.43	4.44	12.5	8.7		6.25	0	2.35	0	50	5.71
KWI03 - 15 - 5B	<.18mm	1.69	62.1	7.72	81	134	79.8	15.6	723	2.68	8.4	0.7	1.4	3.9	50.5	0.43	0.67	0.16	53	3.1	0.07	15.2	74.3	1.1	248	1.53	0.015	0.21	-0.1	5.5	-0.01	110	0.2	0.04	5.1
	<.18mm duplicate	1.7	61.3	7.69	75.1	141	77.1	15	727	2.73	7.8	0.8	1.7	4	52.7	0.44	0.64	0.15	56	3.1	0.07	15.3	99.5	1.12	299	1.67	0.026	0.26	-0.1	5.7	-0.01	97	0.3	0.06	5.5
	% difference	0.59	1.33	0.39	7.56	5.09	3.44	3.92	0.55	1.85	7.41	13.3	19.35	2.53	4.26	2.3	4.58	6.45	5.5	0	2.94	0.66	29	1.8	18.4	8.75	53.66	21.3	0	3.57	0	12.6	40	40	7.55
KWI03 - 15 - 5C	.18 - 1mm	1.97	60.5	7.29	75.7	116	66.9	14	680	2.7	8.6	0.6	2.1	3.9	24.5	0.34	0.68	0.16	50	0.57	0.06	14.2	70.8	0.88	215	1.56	0.014	0.15	-0.1	4.7	-0.01	91	0.3	0.06	5
	.18-1mm duplicate	1.79	59.7	7.22	73.8	101	64.8	13.8	634	2.62	7.5	0.6	5	3.3	24	0.33	0.67	0.16	49	0.54	0.06	14.1	72.4	0.86	206	1.52	0.013	0.15	-0.1	4.9	-0.01	81	0.2	0.06	4.7
	% difference	9.57	1.46	0.96	2.54	13.8	3.19	1.44	7	3.01	13.7	0	81.69	16.7	2.06	2.99	1.48	0	2.02	5.41	4.96	0.71	2.23	2.3	4.37	2.6	7.407	0	0	4.17	0	11.6	40	0	6.19
	STDS-4 standard	1.36	64.4	14.6	84.4	306	23.7	10	1185	2.59	11.7	2	2.7	1.5	58.4	0.37	5.02	0.21	49	1.07	0.08	13.4	31	0.65	1009	1.06	0.033	0.09	0.2	3.1	0.12	817	0.8	0.02	3.7
	CANMET Ref. values*	2	66	13	82	300	23	11	1200	2.6	11	3	4	4.3	350	0.6	3.6		51			24	30		2000				-4	14	0.09	930			
	% difference	-9.52	-0.61	2.92	0.72	0.5	0.75	-2.4	-0.31	-0.1	1.54	-10	-9.701	-24.1	-35.7	-11.9	8.24	50	-1			-14.2	0.82		-16.5				-55.3	-31.9	7.14	-3.23			50

Notes:

Prep. Sediment samples prepared @ GSB, Victoria.
ARMS = 2-2-2-HCl:HNO_3:H_2O digestion - Inductively coupled plasma mass spectrometry (1 gram sample)

ACM = ACME Analytical, Vancouver

% Difference = ABS ((x1-x2)/(x1+x2)/2)x100
CANMET Reference values based on cocentrated HNO_3-HCl digestion

* CANMET Reference value (Bowman, 1994)

Elements B, Ti, Tl were included in analysis, but results were either below detection or unreliable.
For location of samples see Table 1. Instrumental Neutron Activation (INAA) results for Feather Creek.

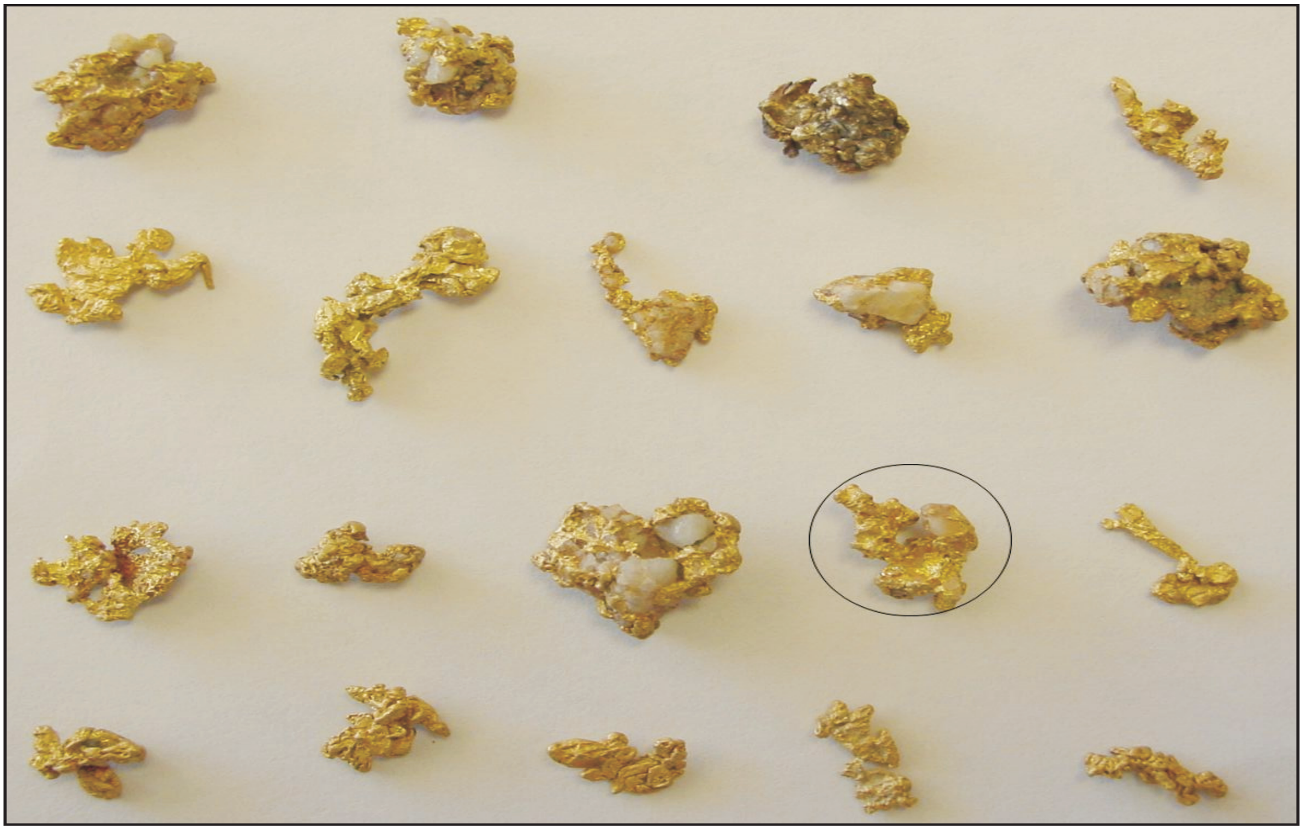

Figure 7. Representative crystalline and hackly gold from Feather Creek which indicates either a proximal source, or transport in clasts that released the gold near its point of recovery

Sample MMI03-24-3 pebbles and granules are about 80% black chert, with minor light grey chert and tan chert. Granitiod granules comprise 15% of the clasts (Figure 5d).

Sample MMI03-24-2A pebbles are 70% wacke, with minor light grey chert, tan chert, cherty wacke, and quartzite. Granules are 60% black chert, 30% light grey chert with minor tan chert, red chert and wacke (Figure 5e).

Sluice box clean-up rejects

Most of the sluice box clean-up reject sample consists of magnetite grains partly cemented with iron oxide and hydroxides. Only about 10% of the sample consisted of the grain size fraction used for the clast identification (> 2 mm). The pebble fraction of sample MMI03-24-4B consists of light grey to tan chert, plus an equal abundance of clumps of magnetite grains cemented by iron-oxide and hydroxides, which results from weathering of the reject pile. The granule fraction is comprised of 75% grey to tan chert, 15% cherty wacke, and 10% vein quartz (Figure 5f).

GEOCHEMICAL RESULTS

ICPES analyses may result in lower gold values than INAA analyses due to the acid digestion in the ICPES not releasing all of the gold. For this reason, the INAA values are considered here (Table 2). ICPES results are shown in Table 3 for comparison and quality control. Sample MMI03-24-4B contained the highest reported gold values, which is expected as the sample was collected from sluice box clean-up rejects. The sample contains mainly heavy minerals that are the product of gravimetric concentration; first in the trommel, and then in the sluice during primary placer gold recovery, and then reconcentrated on an oscillating table during final gold recovery. The +10 and the –80 fractions returned the highest gold values with 17000 ppb and 12700 ppb respectively.

Trench and Creek Sections

Two samples were collected across the unoxidized and oxidized strata of Trench B. The highest gold value is 11 ppb in sample MMI03-24-2A, in the -18 to +80 fraction. This is the only value over 10 ppb from samples collected in this trench.

Two Quaternary and Tertiary stratigraphic samples and one composite sample were collected from Trench C. Composite sample MMI03-24-3 contained 112 ppb Au in the -80 fraction; the highest gold value from a trench. Five other samples from this trench contain gold values above 10 ppb.

Five stratigraphic samples and one composite sample were collected from Trench D. This trench contained the second highest gold value with 85 ppb in sample KWI03-15-4D in the -80 fraction, as well as the third highest gold value in sample KWI03-15-4E with 24 ppb in the -80 fraction. Five other samples from this trench had over 10 ppb gold.

Three stratigraphic samples were collected from Trench E. Sample KWI03-15-5A, is the only sample containing 10 ppb Au, or greater, in the -18 to +80 size fraction.

ATTACHED MINERAL MATTER COMPOSITION

Six nuggets were scanned by SEM and relative elemental abundances in attached mineral matter were obtained with the EDS. Figure 6 contains SEM images of the attached mineral matter. All nuggets are less than 2mm diameter and are hackly, possibly indicating proximity to source, although nuggets in this size fraction are not readily rounded. Nuggets up to 15 mm in size are also crystalline or hackly in nature (Figure 7).

Mineral matter attached to the gold is mainly tin oxide with one grain containing significant thorium (Figure 6b, Table 4: PSA03-1-4). SEM photographs and their accompanying spectra responses are shown in Figure 6.

SUMMARY

Dominant clast types within the Feather Creek placer gravels are: black chert which constitutes at least half of the clasts; grey, tan or red chert; and wacke. Some samples contain significant proportions of quartz or granitoid clasts. Ultramafite or listwanite clasts were not identified in any sample.

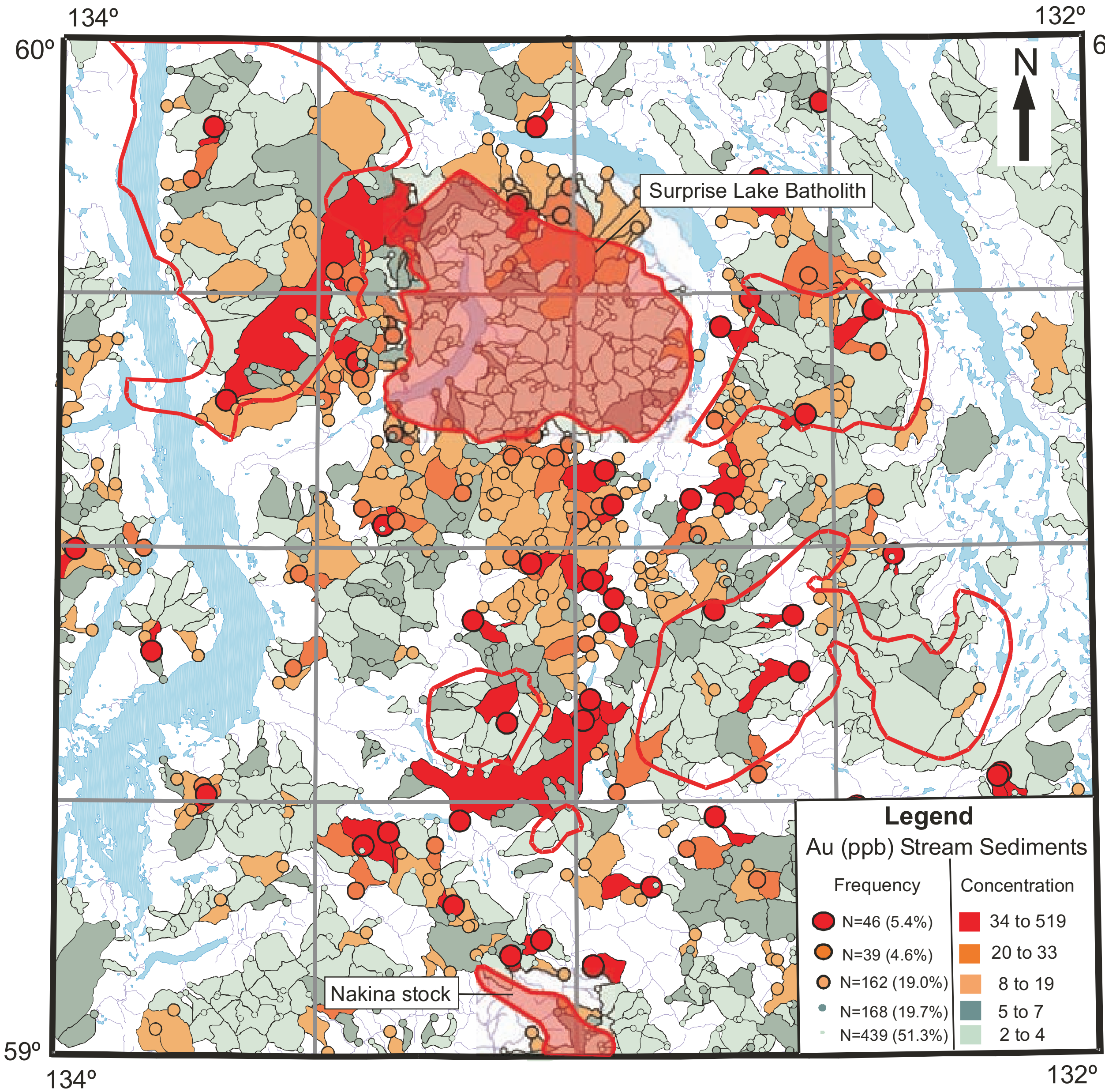

Figure 8. Regional stream geochemistry showing streams draining the margins of plutonic bodies (outlined by heavy red line) including the Surprise Lake batholith and Nakina stocks (shaded), are elevated in gold. Geology after Mihalynuk et al. (1996).

Analyses of gravels from trenches revealed three samples with gold content greater than 20 ppb. The highest value obtained from a trench sample was 112 ppb Au in the -80 fraction of sample MMI03-24-3; followed by 85 ppb in the -80 fraction of sample KWI03-15-4D. Sample KWI03-15-4E has 24 ppb Au in the -80 fraction. For samples containing more than 20 ppb Au, the amount of gold increased as the size fraction decreased.

Two of three samples with the highest gold values contained a significant population of granitoid clasts. The sample with the highest gold value contained 15% granitoid granules, while the sample with 24 ppb Au contained 6% granitoid granules (note that higher gold values were obtained from the sample of sluice clean-up rejects). One sample with 85 ppb gold does not contain granitoid clasts, however, the clast count sample was relatively small (39 clasts) and may not be representative. Overall, the samples analyzed are too small to provide a reliable indication of gold content, and the results of this geochemical orientation study are preliminary and should be verified with geochemical and clast population analysis of much larger samples. Nevertheless, the clues provided by our orientation study corroborate those based on government, regional geochemical stream survey results, and the spatial distribution of placer workings and coarse gold nuggets in proximity to the Surprise Lake batholith.

If gold in the Atlin placer camp bears an association with altered ultramafic rocks, it is not borne out in the juvenile gold placers of Feather Creek. On the contrary, ultramafic or listwanite clast were not identified from these placer gravels. Ascribing the lack of clasts of the ultramafic host rocks to comminution during alluvial transport seems inappropriate given the hackly nature of much of the gold. Gravels with elevated gold do contain a significant proportion of granitoid clasts, as well as ubiquitous sedimentary clasts with lithologies matching geological units within the immediate drainage basin. Does this observation warrant the suggestion of a plutonic-related gold source? On its own, probably not, but combined with the identification of cassiterite in six of six gold nuggets analyzed, a stronger argument can be made for linkage with the evolved, tin-rich Surprise Lake batholith. Further evidence includes, the distribution of 95th percentile gold values in stream sediments collected from streams that drain the flanks of intrusions east of Atlin (Figure 8), as well as the distribution of placer streams, with past and present placer operations on all sides of the Surprise Lake batholith (Figure 1). Finally, consider that the coarsest placer gold is recovered primarily from streams located along the margin of the Surprise Lake batholith. The coarsest gold is recovered from Wright, Otter, Boulder, Ruby, McKee and Spruce creeks (J. Harvey, Personal Communication, 2003). Of these, only the McKee Creek workings are not situated on the margin of the Surprise Lake batholith.

Gold is associated with ultramafic rocks in the Atlin camp as can be shown by the number of lode occurrences in which native gold is seen within listwanite. Perhaps the key to the listwanite-related gold deposition is the late-synorogenic to early post-orogenic granitic batholiths. This is consistent with Middle Jurassic U-Pb ages of chrome micas within the listwanite, which are interpreted as cooling ages related to batholiths such as the Fourth of July body (Ash, 2001). If ophiolites are the source of gold, then other areas in the northern Cache Creek terrane displaying the same listwanite altered zones should also be associated with gold occurrences. One such area would be along the Nahlin ultramafic body where it is cut by large plutons coeval with the Fourth of July batholith (*e.g.* Mihalynuk *et al.*, 2003b). In this region, indications of placer gold are sporadic: an inactive placer in Goldbottom Creek, and gold discovered as part of a heavy mineral sampling program in bulk stream sediment samples from north of Peridotite Peak, as well as near "Scarface Mountain" (Canil *et al.*, this volume; Figure 1). However, no significant placer or lode occurrence has yet been found in this area. It is prudent to ask if these tantalizing specks of gold and bright orange listwanitic alteration zones have not been a mineral exploration red herring but insufficient data exists on which to base resonable conclusions. However, our preliminary results from Feather Creek strongly suggest a link between placer gold and the evolved Surprise Lake batholith, with significant implications for lode gold exploration in the region.

REFERENCES

Aitken, J.D. (1959): Atlin map-area, British Columbia; *Geological Survey of Canada*, Memoir 307, 89 pages.

Ash, C.H. (2001): Relationship between ophiolites and gold-quartz veins in the North American Cordillera; *BC Ministry of Energy and Mines*, Bulletin 108, 140 pages.

Ballantyne, S.B. and MacKinnon, H.F. (1986): Gold in the Atlin Terrane, British Columbia; *in* Gold '86, an international symposium on the geology of gold deposits; poster paper abstracts., Chater (Editor), *Geol. Assoc. Can.*, pages 16-17.

Böhlke, J.K. (1999): Mothe Lode gold; *Geological Society of America*, Special Paper 338, pages 55-67.

Bowman, W.S. (1994): Catalogue of Certified Reference Material; *Canadian Certified Reference Material Project (CCRMP),* CCRMP 94-1E, pages 55-57.

Canil, D., M. Mihalynuk, J.M. MacKenzie, S.T. Johnston, L. Ferreira and B. Grant (2004): Diamond and other indicator minerals in the Atlin-Nakina area (NTS 104N and 104K); *in* Geological Fieldwork, *BC Ministry of Energy and Mines*, Paper 2004-1, this volume.

Clifton, H.E., Hunter, R.E., Swanson, F.J. and Phillips, R.L. (1969): Sample size and meaningful gold analysis; *US Geological Survey*, Professional Paper 625-C, 17 pages.

Dumont, R., Coyle, M. and Potvin, J. (2001): Aeromagnetic total field map British Columbia: Lina Range, NTS 104N/13; *Geological Survey of Canada*, Open File, 4093.

Gebre-Mariam, M., Hagemann, S.G. and Groves D.G. (1995): A classification scheme for epigenetic Archean lode-gold deposits; *Mineralium Deposita*, Volume 30, pages 408- 410.

Hallbauer, D.K. and Utter, T. (1977): Geochemical and morphological characteristics of gold particles from recent river deposits and the fossil placers of the Wittwatersrand; *Mineralium Deposita*, Volume 12, pages 293-306.

Hilchey, G.R. (1990): Techniques of placer exploration and mining in Canada; *Energy of Mines and Resources Canada*, Canadian Exploration Incentive Program, 96 pages.

Jackaman, W. (2000): British Columbia Regional Geochemical Survey, NTS 104N/1 - Atlin; *BC Ministry of Energy and Mines*, BC RGS, 51.

Landefeld, L.A. (1988): The Geology of the Mother Lode Gold Belt, Sierra Nevada Foothills Metamorphic Belt, California; in Proceedings Volume, North American Conference on Tectonic Control of Ore Deposits and the Vertical and Horizontal Extent of Ore Systems, *University of Missouri - Rolla*, pages 47-56.

Lehmann, B. and Grabezhev, A.I. (2000): The Bereznjakovskoje gold trend, southern Urals, Russia - a reply; *Mineralium Deposita*, Volume 35, pages 388-389.

Levson, V.M. (1992): Quaternary geology of the Atlin area (104N/11W, 12E); *in* Geological Fieldwork, *BC Ministry of Energy and Mines*, Paper 1992-1, pages 375-390

Levson, V.M., Kerr, D.E., Lowe, C. and Blythe, H. (2003): Quaternary geology of the Atlin area, British Columbia; *British Columbia Geological Survey Branch*, Geoscience Map 2003-1 and Geological Survey of Canada, Open File 1562, scale 1: 50,000.

Mihalynuk, M.G., Anderson, R.G., Lowe, C., Villeneuve, M., Johnston, S.T., English, J.M. and Cordey, F. (2003a): Atlin TGI update and new massive sulphide discovery in Cache Creek rocks; Cordilleran Exploration Roundup 2003, *British Columbia and Yukon Chamber of Mines*, 6-7.

Mihalynuk, M.G., Johnston, S.T., English, J.M., Cordey, F., Villeneuve, M.J., Rui, L. and Orchard, M.J. (2003b): Atlin TGI Part II: Regional geology and mineralization of the Nakina area (NTS 104N/2W and 3); *in* Geological Fieldwork, *BC Ministry of Energy and Mines*, Paper 2003-1, pages 9-37.

Mihalynuk, M.G., Smith, M., Gabites, J.E., Runkle, D. and Lefebure, D. (1992): Age of emplacement and basement character of the Cache Creek terrane as constrained by new isotopic and geochemical data; *Canadian Journal of Earth Sciences*, Volume 29, pages 2463-2477.

Mihalynuk, M.G. (1999): Geology and mineral resources of the Tagish Lake area, northwestern British Columbia; *BC Ministry of Energy and Mines*, Bulletin 105, 217 pages.

Monger, J.W.H. (1975): Upper Paleozoic rocks of the Atlin terrane; *Geological Survey of Canada,* Paper 74-47, 63 pages.

Robertson, W.F. (1899): Cassiar District; In Annual report of the Minister of Mines, 1898, *BC Department of Mines*, pages 985-991.

Royle, A.G. (1987):Alluvial sampling formula and recent advances in alluvial deposit evaluation; *Extractive industry geology '87*, 4 pages.Heavy Mineral Sampling of Stream Sediments for