Irarsite (IrAsS), Osarsite (OsAsS) and Gold from Placer Black Sands, Ruby Creek and Wright Creek, Atlin, British Columbia

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KEYWORDS: Placer mineralogy, platinum group elements, PGE, osarsite, irarsite, osmium, iridium, placer gold, pure gold rims

INTRODUCTION

Atlin gold placers have been known to contain a wide variety of metallic minerals for almost one hundred years. T.L. Gledhill (1921) lists among others iridosmine, cassiterite, wolframite, magnetite, native gold, copper, bismuth, chalcopyrite, pyrite, amalgam and mercury. Some mineral relationships observed from black sands of Feather Creek were published recently by Sack and Mihalynuk (2004). For this study, three samples of about 10 grams each comprising 2 mm hand-panned black sand were provided by M. Mihalynuk from Ruby, Wright and Feather creeks. The samples were observed under the microscope and analyzed by the electron microprobe. The results are presented below.

GEOLOGY

The Atlin placer camp, located on the east side of Atlin Lake, is underlain by the northern Cache Creek terrane (Figure 1). In the Atlin area, this terrane consists of oceanic sedimentary strata of Mississippian to Jurassic age, ophiolitic rocks of Late Permian to Triassic age, and Middle Jurassic, Cretaceous and Tertiary plutons (Sack and Mihalynuk, 2004) (Figure 2). Valleys originally cut deep into bedrock, are now fluvially modified and filled by glacial and glaciofluvial deposits. Some of the placer deposits may be interglacial in age but most are probably preglacial (Levson, 1992). Postglacial placers are reworked, mostly deeply buried, original fluvial placers and are usually less productive. The original gravels rich in gold are characteristically oxidized and red in colour, deposited locally on altered bedrock (Levson, 1992) or on a bouldery till (Sack and Mihalynuk, 2004).

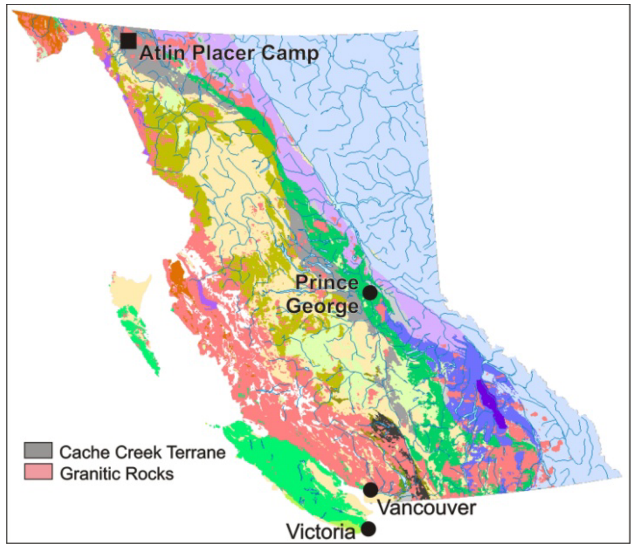

Figure 1. Location of study area.

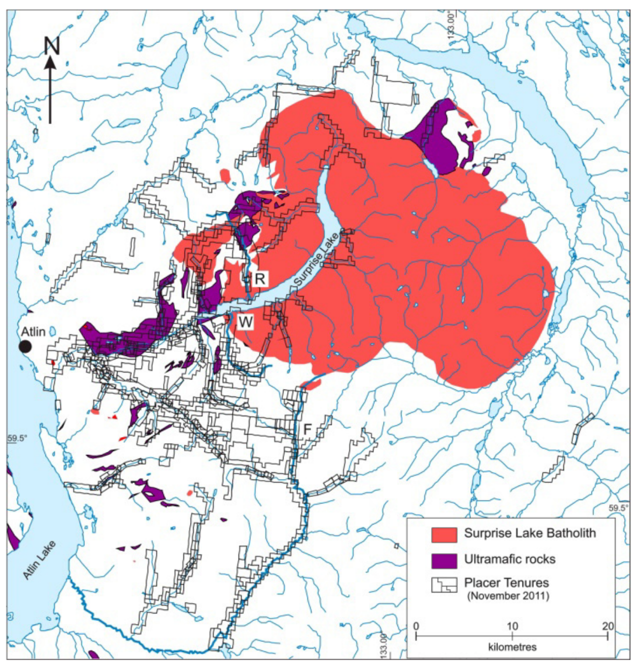

Figure 2. Map of the Atlin placer camp with placer tenures as of November 2011. Creeks discussed in the text : R=Ruby Creek, W=Wright Creek, F=Feather Creek.

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SAMPLE PREPARATION AND ANALYTICAL PROCEDURES

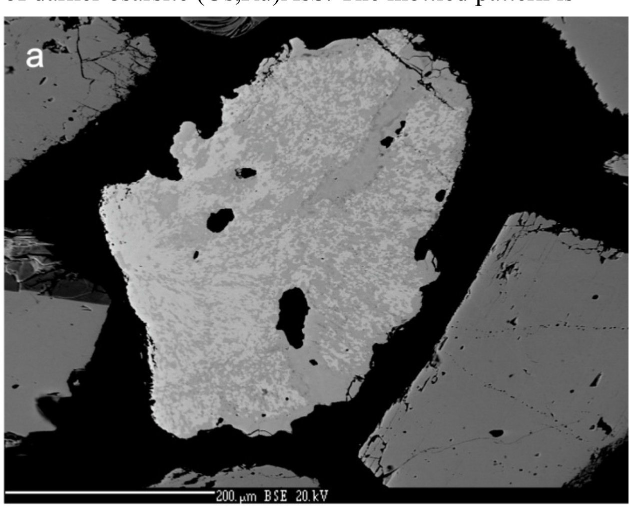
After microscopic examination, a small part of each black sand sample was cemented by synthetic resin, cut and made into polished sections to undergo electron probe analysis. This study focused on platinoids and gold.

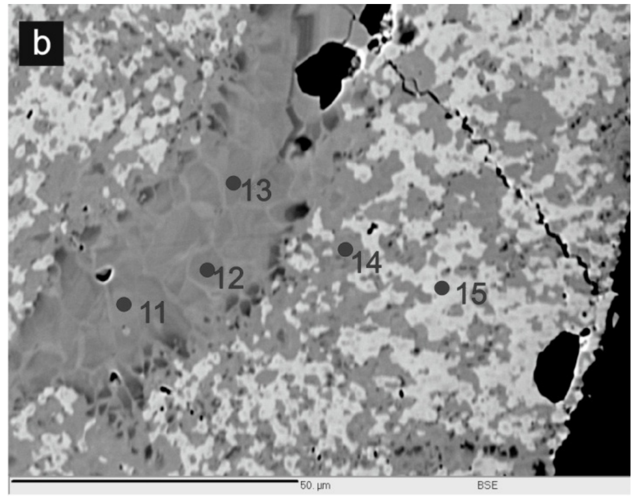
Mineral analyses were made with a CAMECA SX-100 electron probe using the wavelength dispersive technique. The beam diameter was 2 µm with an accelerating potential of 20 kV. A beam current of 6 µA was measured on a Faraday cup. A counting time of 10 s was used for all elements. The standards employed were : sphalerite (S Kα), FeS_2 (Fe Kα), GaAs (As Lα), and 100% metals for Rh Lα, Os Mα, Ru Lα, Ni Kα, Re Mα, Pt Mβ, Ir Mβ. Correcting for overlapping peaks were made for Os Mα (Re Mβ1) and Rh Lα (Ir L13). The data were reduced using the $\phi(\rho z)$ Merlet correction procedure.

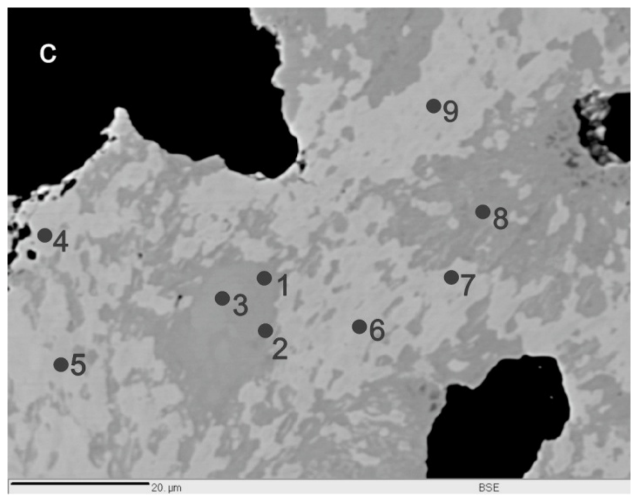
Sample mineralogy

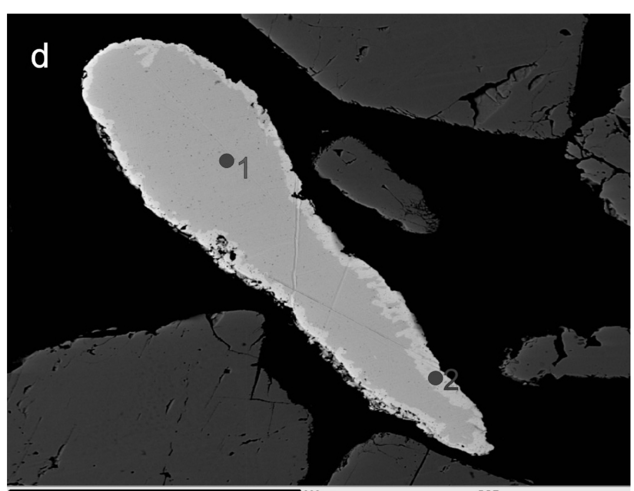
A fairly complex Ruby Creek composition of black sand has been published by Gledhill (1921). Our cursory examination confirmed the presence of gold, magnetite, wolframite and cassiterite. Iridosmine described by Gledhill was not detected. Wright Creek sample contains frequent small grains of magnetite, different shades of brown particles of iron oxides, pyrite, and relatively large particles of bright yellow gold. Feather Creek sample is dominated by magnetite, with some pyrite of silvery bluish colour. Compound gold-cassiterite grains described by Sack and Mihalynuk (2004) were not found.

Particles of gold are very common in Ruby Creek. A single silvery grain contains a suite of PGE with As and S. This irregularly-rounded grain (400 by 300 µm in size) is light grey in reflected light with metallic lustre. Its shape and texture are shown in Figure 3 a, b, c. The analytical results are listed in Table 1 and location of analytical points in Figure 3. The grain is an intimate intergrowth of two minerals. The lighter colour matrix is irarsite (Ir,Ru,Rh,Pt)AsS, with many irregular inclusions of darker osarsite (Os,Ru)AsS. The mottled pattern is most probably a result of immiscibility between a cubic structure of irarsite with its isomorphic Rh and Pt phases and monoclinic osarsite with its isomorphic Ru member. The results of 15 analytical points is in agreement with this interpretation. As shown in Table 1, the Pt and Rh values are higher in irarsite, while Ru values are high in osarsite.









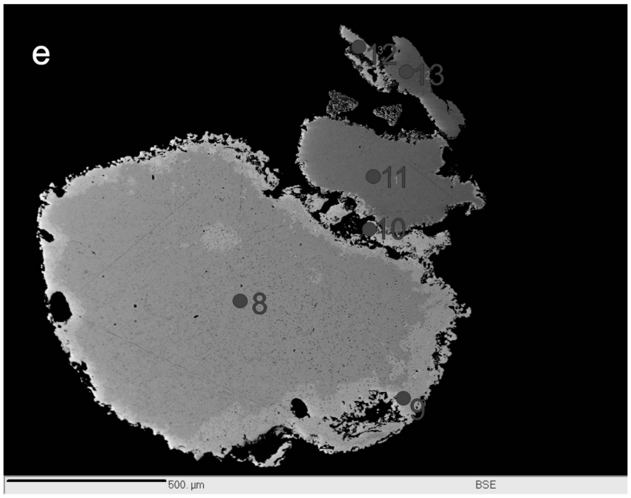


Figure 3. Scanning electron microscope photomicrographs showing: (a) a PGE grain, Ruby Creek; scale bar 200 µm. (b) analytical points of osarsite-rich detail, Ruby Creek; scale bar 50 µm; points correspond to analytical data in Table 1. (c) the osarsite–irarsite intergrowth texture, Ruby Creek; scale bar 20 µm. (d) an electrum grain with gold rim, Ruby Creek; scale bar 200 µm; analytical points 3–7 are outside the field of view; points correspond to analytical data in Table 2. (e) electrum grains with gold rim, Wright Creek; scale bar 500 µm.

The logical source of this mineral is the Atlin ophiolitic terrane with its ultramafic to mafic rocks. The high Ru content in osarsite is in agreement with conclusions of Barkov *et al.* (2005, 2007) based on a study of PGE metals and alloys which also included samples from the Atlin area. While irarsite is a relatively common component in both PGE placer and lode deposits in general, the osarsite occurrences are known from few placers worldwide.

Little particles of gold are a common component of samples from both Ruby and Wright Creeks. It is present in irregular, rounded grains of electrum (22 to 31 % of Ag) up to 100µm in size, with irregular, thin (up to 5µm) rims of high purity gold (Table 2). Such rims are known from numerous sites around the globe and there are two different interpretations for their origin. Knight *et al.* (1999) presents a well documented case linking placer gold with rims to its identified bedrock sources in Klondike District, Yukon. The interpretation of high purity rims has been linked to removal of Ag, Hg and Cu from the gold. The particle shape and width of the rim depends on the distance of transport from the primary source. The authors suggest that the rim may thicken in

Table 1. Electron probe analyses of osarsite and irarsite from Ruby Creek compared to composition of international standards.

Osarsite (Os,Ru)AsS, Ruby Creek, Atlin area, British Columbia

AP	As	Ir	Ru	Pt	Rh	S	Os	Fe	Ni	Re	wt.%
A	30.6	2	18.1	0.4	0.2	11.5	35.6		0.9		99.3
1	28.02	2.92	12.61	0	0.18	11.3	45.75	0	0.02	0	100.8
2	27.77	2.51	13.25	0	0.21	11.24	45.82	0	0.02	0	100.8
3	28.61	3.31	14.57	0	0.4	11.29	42.39	0.03	0.08	0	100.7
8	29.05	4.5	12.9	0	0.29	11.1	42.07	0	0.14	0.05	100.1
11	29.68	2.29	15.04	0	0.21	11.19	42.08	0.03	0.1	0.02	100.6
12	30.37	3.03	17.55	0	0.2	11.18	37.83	0.09	0.19	0.02	100.5
13	29.11	2.33	16.43	0	0.15	11.46	39.68	0.02	0.22	0.12	99.52
14	29.23	3.22	15.53	0	0.1	11.22	39.92	0.06	0.07	0.01	99.36

Irarsite (Ir,Ru,Rh,Pt)AsS , Ruby Creek, Atlin area, British Columbia

AP	As	Ir	Ru	Pt	Rh	S	Os	Fe	Ni	Re	wt.%
B	26.0	43.5	5.5	11.7	7.4	9.6					103.7
4	24.32	49.84	2.06	5.98	0.81	11.24	2.57	0	1.02	0	97.84
5	23.93	49.51	3.05	7.31	1.15	11.82	1.62	0.03	0.77	0	99.19
6	25.01	49.1	3.02	7.45	1.05	11.47	1.86	0	0.77	0.22	99.95
7	24.79	49.64	2.61	7.36	1.11	10.85	1.74	0	0.7	0	98.8
9	24.75	51.32	2.35	6.7	0.87	11.28	1.69	0.01	0.94	0	99.91
10	24.51	48.99	2.9	6.96	0.98	11.86	2.3	0.06	0.94	0.02	99.52
15	25.87	48.47	2.85	7.5	1.05	11.23	2.12	0	0.72	0	99.81

Remarks:
A - analytical data from Snetsinger (1972), Gold Bluff, California (+Pd 0.6)
B - analytical data from Johan *et al.* (2000), Papua New Guinea (+Cu 0.6, Pd 0.4)
AP - analytical points

Table 2. Electron probe analyses of electrum and gold grain rims from Ruby and Wright creeks.

Gold grains from placers in Atlin area, British Columbia

AP	Ag	Au	wt.%
1	27.40	71.96	99.36
2*	2.50	96.77	99.27
3	33.83	66.76	100.6
4*	2.29	99.84	102.1
5	22.66	77.94	100.6
6	22.51	79.01	101.5
7*	1.93	98.71	100.6
8	13.09	86.43	99.52
9*	0.01	98.13	98.14
10*	1.25	72.74	73.99
11	24.65	75.65	100.3
12	30.78	69.88	100.7
13	31.01	69.32	100.3

Remarks:
Points 1-7 - Ruby Creek
* rims
Points 8-13 - Wright Creek
AP - analytical points

dormant placers while getting removed by abrasion in active placers.

A different interpretation is presented by Groen *et al.* (1990), Eyles (1990), Eyles and Kocsis (1989) and Bakos, at al. (2004). The origin of gold rims is explained as a result of a supergene gold mobility as a thiosulphate ion under basic to neutral conditions. Also, humic acids in the presence of dense vegetation enable gold mobility in subsurface waters. Under favourable conditions, such as change in pH or temperature, the gold may precipitate. Such precipitation could be triggered by the presence of older gold grains, detrital organics, or newly formed iron sulphides.

The main gold-bearing gravels in both Wright and Ruby Creeks are described as heavily oxidized rusty coloured, strongly cemented, iron and manganese oxide rich gravels deposited on bedrock (Levson, 1992) or on a glacial till (Sack and Mihalynuk, 2004). Such a heavily oxidized environment suggests that the gold rims may be a product of supergene gold mobility such as suspected for the Cariboo Mining District by Eyles (1990), or the Danube River placers in Slovakia by Bakos *et al.* (2004).

The bedrock source for Atlin gold still remains to be identified. However, the distribution of placer streams on all sides of the Surprise Lake batholith, the coarsest placer gold recovered primarily from streams located along its margins and association of some gold grains with cassiterite suggest that a link between placer gold and the Surprise Lake batholith may exist (Sack and Mihalynuk, 2004).

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