PRELIMINARY INVESTIGATION OF PLATINUM CONTENT OF SOILS AND SEDIMENTS, SOUTHERN BRITISH COLUMBIA (82E/9, 92H/7, 10, 92I/14)

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INTRODUCTION

An almost complete lack of information on the distribution of platinum in soils and sediments is limiting application of exploration geochemical methods to the search for platinum deposits in British Columbia. As part of an ongoing study, this paper reports results of preliminary investigations of the platinum and palladium content of soils and sediments from the Franklin mining district (82E/9) near Grand Forks, from the Tulameen ultramafic complex (92H/7 and 92H/10) and from Scottie Creek, north of Cache Creek (92I/14).

DESCRIPTION OF STUDY AREAS AND SAMPLE LOCATIONS

Study area locations are shown in Figure 5-5-1.

FRANKLIN CAMP (82E/9)

The Franklin camp lies between Franklin and Gloucester creeks approximately 70 kilometres north of Grand Forks. Platinum is associated with pyroxenite bodies in the alkaline Averill plutonic complex (Keep and Russell, 1988). Thomlinson, quoted in Rublee (1986), reported platinum grades between 1.37 and 15.4 grams per tonne in pyroxenite samples carrying pyrite and chalcopyrite. Sperrylite is the major platinum mineral.

Bulk sediment samples were collected from Franklin and Gloucester creeks approximately 0.5 and 2 kilometres above their confluences with Burrell Creek. Soils were sampled in three pits on the Platinum Blonde property. All three sites were on steep slopes where overburden either contained abundant pyroxenite float or consisted of a disintegrated pyroxenite sand. Platinum values ranging from 10 to 45 ppb had been reported from the area in an earlier soil geochemical survey (Placer Dome Inc., personal communication).

TULAMEEN ULTRAMAFIC COMPLEX (92H/7, 92H/10)

The Tulameen ultramafic complex, approximately 25 kilometres west of Princeton, has recently been remapped and its geological history reinterpreted by Nixon and Rublee (1988). Principal ultramafic/mafic units are dunite, olivine and hornblende clinopyroxenites, and gabbroic rocks. The dunite, which forms a core to the northern part of the complex between Olivine and Grasshopper mountains, is deeply dissected by the valley of the Tulameen River. Platinum (and the other platinum group metals except palladium) occur in platinum-iron alloys associated with chromitite pods and schlieren in the dunite (St. Louis *et al.*, 1986; Bohme, 1987, 1988).

The area has been glaciated from the north and till is widely distributed except near the summits of Olivine and Grasshopper mountains and on steep talus-covered slopes. Till and ultramafic colluvium are often mixed in overburden profiles. Fluvioglacial sediments have been deposited along the lower slopes of the Tulameen River valley.

Soil samples were taken from disintegrating dunite colluvium near the summit of Olivine Mountain and from mixed till and dunite colluvium on Grasshopper Mountain. Profile 6 on Grasshopper Mountain is immediately downslope from a platinum-rich chromite showing in the dunite. Sediment samples were collected near the mouths of Britton and Olivine creeks.

SCOTTIE CREEK (92I/14)

The Scottie Creek chromite showings, approximately 20 kilometres north of Cache Creek and 5 kilometres east of

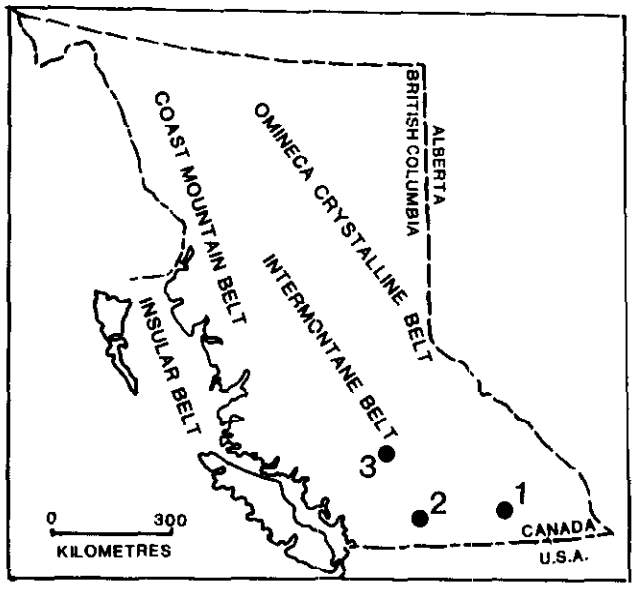

Figure 5-5-1. Location of study areas: 1 – Franklin mining district; 2 – Tulameen ultramafic complex; 3 – Scottie Creek.

British Columbia Ministry of Energy, Mines and Petroleum Resources, Geological Fieldwork, 1988, Paper 1989-1.

Highway 97, are associated with serpentinized peridotites and dunites in Chrome Creek above its junction with Scottie Creek. Thomlinson (quoted in Rublee, 1986) reported values of 1.37 to 4.8 grams per tonne platinum in panned samples from the creek.

Except on the steeper slopes, bedrock is generally concealed beneath thick deposits of glacial till and fluvioglacial sediments. However, the soil profiles sampled were developed on ultamafic colluvium and talus at the base of two knobs of serpentinized ultramafite. A bulk sediment sample was collected from Scottie Creek approximately 1 kilometre below its confluence with Chrome Creek.

METHODS

FIELD SAMPLING

Soil sampling sites were selected, either by resampling sites previously reported to give high platinum values or because of their proximity to known platinum mineralization; this was done to increase the chance of having abnormally high platinum contents. During site selection it was noted that tills and fluvioglacial deposits are important components of the geochemical landscape in all three study areas and that platinum-rich sites usually occur on steeper slopes where locally derived ultramafic colluvium is abundant. At each of the selected sites a soil pit was dug and bulk samples (approximately 10 kilograms) taken of each of the principal soil horizons.

Sediment samples were collected from streams draining platiniferous areas by wet sieving sufficient gravel from a high-energy site to obtain 50 kilograms of 10 mesh material. More comprehensive suites of sediments were collected from the Franklin Camp and Tulameen ultramafic complex by Matysek (1988).

SAMPLE PREPARATION

Wet sieving was used to prepare three soil size-fractions (−10+40, −40+70 and −70 mesh) and seven sediment fractions (−10+40, −40+70, −70+100, −100+140, −140+200, −200+270 and −270 mesh). Sediment fractions between 70 and 270 mesh were then separated into light and heavy mineral density fractions using methylene iodide (SG 3.3). All fractions were dried, weighed, pulverized in a ring mill and split with a Jones riffle to obtain subsamples for analysis.

On the basis of preliminary analytical results and availability of material, heavy mineral concentrates from selected soils were further separated into magnetic and nonmagnetic fractions using a hand-held piston magnet.

ANALYSIS

Samples were submitted to a commercial laboratory for determination of platinum and palladium on 10-gram subsamples using a lead fire assay in conjunction with an inductively coupled plasma mass spectrograph (ICP-MS) finish. Results of replicate determinations are summarized in Table 5-5-1. It is not known to what extent the variability observed reflects analytical variability or lack of homogeneity among 10-gram splits. The latter, however, is likely to be a major source of variation if platinum is present as very rare platinum-rich particles.

TABLE 5-5-1
REPLICATE DETERMINATIONS OF Pt AND Pd: REPLICATES ARE ON SPLITS OF SAMPLES PULVERIZED IN A RING MILL.

Sample No.	Pt (ppb)	Pd (ppb)
87-KF-46	72	228
	74	372
	91	356
	71	243
87-KF-54	143	5
	157	56
	179	38
	235	11
	145	11
UBC-Pt-5	385	4
	389	4
	270	5
	572	4
	435	3
	431	3
	530	4
	231	2

TABLE 5-5-2
Pt AND Pd CONCENTRATIONS (ppb) IN SOILS, FRANKLIN CAMP, SOUTHERN BRITISH COLUMBIA.

Depth (cm)	Horizon	−40+70		−70	
		Pt	Pd	Pt	Pd
Profile 1					
0–20	A	6	9	11	7
20–55	B	7	15	6	14
55–85	C	7	15	22	22
Profile 2					
0–15	A	33	27	21	32
15–75	B/C	11	25	8	4
Profile 3					
0–20	A	31	60	34	88
20–80	B/C	24	128	67	181

RESULTS

FRANKLIN CAMP

Concentrations of platinum and palladium in soils range from 6 to 67 ppb and 4 to 181 ppb, respectively (Table 5-5-2). There is no strong partitioning of either element between the −40+70 and the −70 mesh fractions or between the poorly developed soil horizons. There is, however, a rough relationship between platinum and palladium contents and the abundance of pyroxenite float, with the highest concentrations of both elements in Profile 3 on the edge of a talus slope. This profile consists of about 70 per cent friable, decomposing pyroxenite float. In contrast, the lowest values are in Profile 1 that contains about 10 per cent pyroxenite float.

Platinum and palladium concentrations in all size fractions of light minerals from Franklin and Gloucester creeks are 3

ppb or lower. Concentrations in the heavy mineral fractions are only slightly higher, with a maximum value of 10 ppb (Table 5-5-3). It is interesting to note that O'Neil and Gunning (quoted in Rublee, 1986) reported 1.03 grams per tonne platinum in a panned concentrate taken near the mouth of Franklin Creek, although such a value may easily be influenced by site selection or sample size.

TABLE 5-5-3
Pt AND Pd CONCENTRATIONS (ppb) IN STREAM SEDIMENTS, FRANKLIN CAMP, SOUTHERN BRITISH COLUMBIA.

Size fraction (ASTM)	Lights		Heavies	
	Pt	Pd	Pt	Pd
Franklin Creek				
−70+100	2	3	7	6
−100+140	2	2	3	10
−140+200	2	2	4	9
−200+270	2	2	2	8
−270*			2	3
Gloucester Creek				
−70+100	2	2	3	5
−100+140	2	2	3	6
−140+200	2	2	2	2
−200+270	2	2	3	nd
−270*			2	3

* Lights + heavies.

TABLE 5-5-4
Pt AND Pd CONCENTRATIONS (ppb) IN SOILS, TULAMEEN ULTRAMAFIC COMPLEX SOUTHERN BRITISH COLUMBIA.

Depth (cm)	Horizon	−40+70		−70	
		Pt	Pd	Pt	Pd
OLIVINE MOUNTAIN					
Profile 4					
0–20	A/C	155	3	54	2
Profile 5					
0–25	A	115	3	61	2
25–50	B/C	69	3	26	2
GRASSHOPPER MOUNTAIN					
Profile 6					
0–10	A	27	7	28	2
10–28	B/C	48	6	38	4
28–70	C	22	6	30	6
Profile 7					
0–20	A/C	17	42	15	5

TULAMEEN ULTRAMAFIC COMPLEX

With one exception, palladium values in soils are less than 10 ppb (Table 5-5-4). Associated platinum concentrations range from 15 to 155 ppb with the highest values in residual soils derived from disintegrating dunite near the summit of Olivine Mountain. Heavy minerals from these soils contain up to almost 500 ppb platinum (Table 5-5-5).

In Profile 6, immediately downslope from platinum-rich chromite showings on Grasshopper Mountain, soils on mixed till and dunite colluvium contain 22 to 48 ppb platinum. More detailed studies of the C-horizon of this profile indicate that most of the platinum is in a magnetic heavy mineral fraction that contains from 138 to 210 ppb platinum depending on the size fraction (Table 5-5-5).

Platinum content of stream sediments shows a very clean partitioning between the light and heavy mineral fractions with the latter containing up to 522 ppb platinum (Table 5-5-6). However, distribution of platinum between the different size fractions is erratic and shows no obvious trends.

TABLE 5-5-5
Pt AND Pd CONCENTRATIONS (ppb) IN HEAVY MINERALS (SG>3.3) FROM SELECTED SOIL SAMPLES

Size fraction (ASTM)	Magnetic		Non magnetic		Combined Mag. & Non mag.	
	Pt	Pd	Pt	Pd	Pt	Pd
Olivine Mtn. (Profile 4, Table 5-5-4)						
−40+ 70	NO DATA		NO DATA		446	5
− 70+100					140	2
−100+140					159	2
−140+200					489	30
−200+270					319	9
Grasshopper Mtn. (Profile 6, Table 5-5-4)						
−40+ 70	138	6	19	7	NO DATA	
− 70+100	202	9	27	37		
−100+140	159	6	16	18		
−140+200	210	7	84	19		
−200+270	204	5	101	27		

TABLE 5-5-6
Pt AND Pd CONCENTRATIONS (ppb) IN STREAM SEDIMENTS, TULAMEEN ULTRAMAFIC COMPLEX, SOUTHERN BRITISH COLUMBIA.

Size fraction (ASTM)	Lights		Heavies	
	Pt	Pd	Pt	Pd
Britton Creek				
−70+100	2	3	336	8
−100+140	2	2	41	6
−140+200	2	2	46	3
−200+270	2	2	522	4
−270*			7	2
Olivine Creek				
−70+100	2	3	25	12
−100+140	3	4	25	1
−140+200	3	5	204	17
−200+270	6	3	329	19
−270*			29	8

* Lights + heavies.

TABLE 5-5-7
Pt AND Pd CONCENTRATIONS (ppb) IN SOILS, SCOTTIE CREEK, SOUTHERN BRITISH COLUMBIA.

Depth (cm)	Horizon	−40+70		−70	
		Pt	Pd	Pt	Pd
Profile 8					
0– 45	A/C	2	2	2	4
45–100	C	2	3	3	4
Profile 9					
0– 20	A	6	4	8	8
20– 60	B	8	5	10	16
60–100	C	10	8	10	31

SCOTTIE CREEK

Platinum and palladium concentrations in soils developed on ultramafic colluvium range from 2 to 10 ppb and 4 to 31 ppb, respectively (Table 5-5-7). Concentrations in both light and heavy mineral fractions of a sediment sample from Scottie Creek are similarly low (Table 5-5-8).

TABLE 5-5-8
Pt AND Pd CONCENTRATIONS (ppb) IN STREAM SEDIMENTS, SCOTTIE CREEK, SOUTHERN BRITISH COLUMBIA.

Size fraction (ASTM)	Lights		Heavies	
	Pt	Pd	Pt	Pd
−70+100	2	3	2	4
−100+140	2	2	2	5
−140+200	2	2	3	3
−200+270	2	2	2	11
−270*			2	2

* Lights + heavies.

DISCUSSION

Although the results are of a very preliminary nature, several aspects of the data may be of general significance:

- As might be expected, concentrations of platinum in soils appear to be crudely related to the amount of ultramafic float present in the soil profile. For example, soils formed from weathered dunite on Olivine Mountain have much higher platinum values than soils from Grasshopper Mountain where till and local dunite colluvium are mixed. Soil geochemical maps for platinum will therefore tend to reflect the extent to which materials derived from different sources have been mixed. It follows that it will be difficult to interpret soil geochemical data unless it is accompanied by information on the distribution of glacially derived material and ultramafic float.
- Partly as a result of dilution by till, platinum concentrations in soils near known platinum mineralization are often below 50 ppb. More reliable results should be obtainable by determining the mode of occurrence of platinum in the soils as a basis for preconcentrating it into a suitable density or mineralogical fraction prior to analysis. Preliminary data from Grasshopper Mountain indicate concentration of platinum into the magnetic, heavy mineral fraction. This, however, requires verification and may not be the case in other areas.
- In the poorly differentiated soils examined in this study, platinum does not show any particular redistribution or trend between either soil horizons or size fractions.
- Where relatively high concentrations of platinum are present in drainage sediments (for example, Britton and Olivine creeks, Tulameen district), there is a very clean partitioning of the platinum into the heavy mineral fraction. The forms of platinum present in the heavy mineral fraction have still to be established.

On the basis of these results, more detailed studies of the distribution and behaviour of platinum and associated elements in the surficial environment are now underway on Grasshopper Mountain in the Tulameen district.

CONCLUSIONS

Platinum concentrations in soils tend to reflect the amount of ultramafic float in the profile. However, as a result of dilution by till, concentrations close to known bedrock occurrences are often less than 50 ppb. In poorly developed soil profiles there is no obvious redistribution of platinum between soil horizons or size fractions. In drainage sediments platinum is very cleanly partitioned into the heavy mineral fraction.

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