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GOLD RECOVERY AND KIMBERLITE/DIAMOND INDICATORS FROM CRIPPLE CREEK, ROCKY MOUNTAIN FOOTHILLS, ALBERTA

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Introduction

Panning more than a few flecks of gold from most streams in Alberta is unusual, except for the Red Deer and North Saskatchewan rivers (Edwards and Scafe 1996). A gravel sample, collected from Cripple Creek in the Rocky Mountain Foothills as part of a regional study of Tertiary drainage, yielded an anomalous amount of gold from the pan concentrate. Heavy mineral and diamond-indicator analyses of the same sample yielded chromites having potential affinities with the diamond intergrowth and inclusion field.

Site

Cripple Creek is tributary to the North Ram River in west-central Alberta (Fig. 1). The site lies approximately 72 km southwest of Rocky Mountain House and 33 km south of Nordegg, and is reached by the Forestry Trunk Road.

Methods

The sample was collected from a coarse gravel bar in the stream bed. Approximately 50 kg of gravel were sieved and hand panned to recover the concentrate. Heavy mineral separation and gold analyses was carried out by the Saskatchewan Research Council, Geochemical Laboratory and analysis of the heavy mineral separates was carried out at the University of Calgary. For chromite analysis, an ARL semi-automated electron microprobe (wavelength dispersive), with an inline energy dispersive spectrometer (EDS) used to obtain weight percent.

Results

Results of processing for heavy minerals (by Saskatchewan Research Council Geochemical Laboratory) are summarized in Table 1A.

Gold

Nineteen gold grains were recovered having total estimated weight of 365.83 micrograms. The grains have sub-millimetre dimensions, ranging from 20 x 40 μm to 360 x 580 μm (Table 1). Four grains have larger dimensions than normally reported from Alberta (>300 μm).

Indicator Minerals

Heavy mineral analyses were undertaken for evidence of kimberlites or related intrusions. No chrome diopsides or unequivocal pyrope garnets were recovered and no ilmenites with significant diamond indicator potential (>4 wt% MgO) were recovered.

Garnets - Other than one possible pyrope garnet identified from the indicator mineral grain description, no garnets were identified.

Chromite - Ten chromite samples were found in the pan concentrate. Chromium content ranges from 35.95 to 63.01 wt% (Table 1C). A plot of TiO_2 (wt%) vs. Cr_2O_3 (wt%) is given in Fig. 2A, and a plot of MgO (wt%) vs. Cr_2O_3 (wt%) is given in Fig. 2B. Chromites associated with diamonds are high in chromium (57.8 - 69 wt%), low in titanium (< 0.6 wt%), and moderate to high magnesium (8.7 - 18.7 wt%) content ("diamond intergrowth field", Figs. 2A and 2B). Because chromium content is pressure dependent, high Cr_2O_3 is considered the most critical indicator of diamond potential. However, moderate to high chromium (36.3 - 63.66 wt%) with high titanium (0.8 - 8.7 wt%) chromites are also important, because they are found only in kimberlites and lamproites ("field unique to lamproites and kimberlites", Fig. 2A).

All the chromites from the Cripple Creek sample are from a mafic or ultra-mafic source, which could include kimberlite and lamproite. Of particular interest are grains #92 and #97 which plot within the diamond intergrowth and inclusion field (Fig. 2A) and very close to the diamond intergrowth and inclusion field (Fig. 2B). According to criteria outlined in Fipke et al. (1995), these two grains are definitely from kimberlitic or lamproitic sources, perhaps even diamond-bearing ones. If the MgO content of these two grains were slightly higher (e.g. plot in the diamond intergrowth and inclusion field in Fig. 2B) one would conclude they were very likely from diamondiferous kimberlites.

Conclusions

- Stream bed sediment in Cripple Creek contains anomalously large gold grains compared with most rivers in Alberta.
- Heavy mineral analysis shows that none of the grains definitively originate from a diamond-bearing kimberlite, based on criteria of Fipke et al. (1995). Two chromite grains from Cripple Creek come close; containing sufficient Cr_2O_3 to qualify as true diamond indicator minerals but slightly lacking in MgO. The chromites come from an ultramafic igneous source, possibly kimberlite and/or lamproite.
- The findings above suggest that further study on the stream sediment provenance and drainage basin analysis in the area is warranted. The present watershed is relatively small.

Acknowledgments

Heavy mineral separation was carried out by the Saskatchewan Research Council.

References

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Fipke, C.E., Gurney, J.J., Moore, R.O. 1995. Diamond exploration emphasizing indicator mineral geochemistry and Canadian examples. Geological Survey of Canada, Bulletin 423, 89 p.

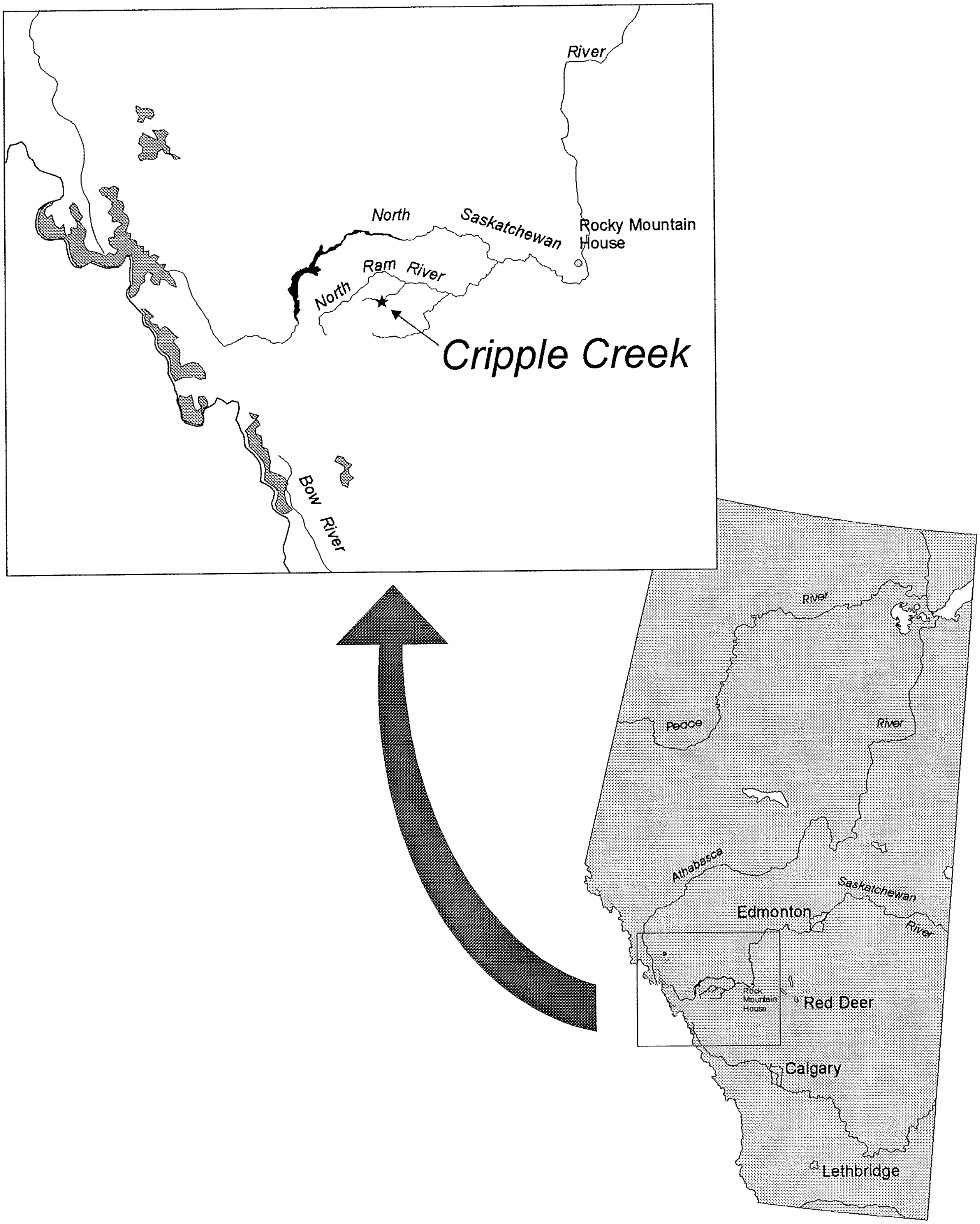

FIGURE 1. Location of Cripple Creek. The site is near the mountain front. Ice fields feeding the head waters of the major rivers are shown in darker stipple.

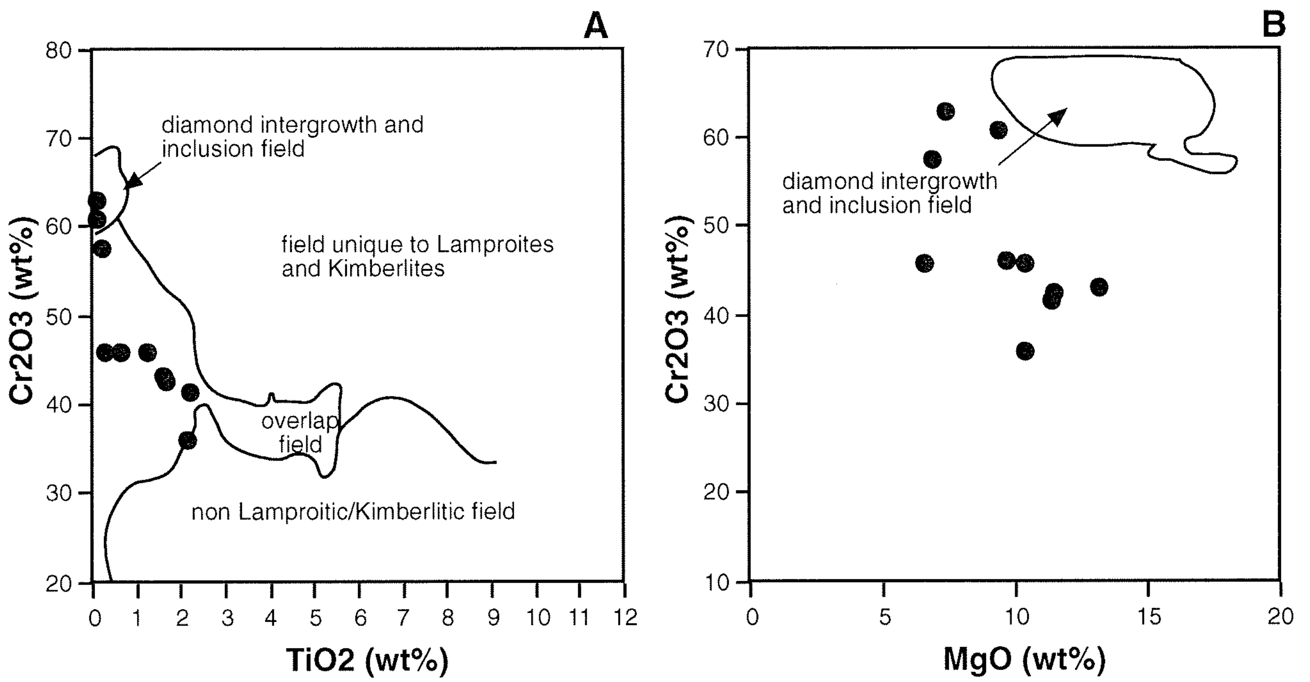

FIGURE 2. A) TiO2 vs. Cr2O3 for Cripple Creek chromites. Boundaries of compositional areas from Fipke et al. (1995). B) MgO vs. Cr2O3 for Cripple Creek chromites. Boundaries of compositional areas from Fipke et al. (1995).

TABLE 1A: GOLD AND DIAMOND INDICATOR MINERAL RECOVERY

Sample	*Pyropic Garnets*	*Chrome Diopside*	*Visible Gold Grains*	*Weight (micro-grams)*
*	0	0	19	365.83

*: sample from concentrate panned in field   Weight: estimated from gold dimensions

TABLE 1B: GOLD GRAIN DIMENSIONS

Sample	*Width (μ)*	*Length (μ)*	*Depth*
1	20	40	A
2	80	140	I/A
3	80	160	A
4	80	120	A
5	80	120	A/I
6	100	140	A
7	120	160	A
8	140	200	I/A
9	140	260	A
10	160	200	A
11	160	240	I/A
12	180	180	I/A
13	180	240	A/I
14	180	280	A/I
15	240	340	I/A
16	260	220	A
17	300	420	I/A
18	300	300	I/A
19	360	580	I/A

TABLE 1C: CHROMITE ANALYSES

Sample	*SiO2*	*TiO2*	*Al2O3*	*FeO*	*MgO*	*CaO*	*Na2O*	*F*	*Cr2O3*	*Total*
91	0.03	2.12	17.46	33.23	10.28	0.0	0.01	0.0	35.95	99.08
92	0.01	0.03	6.43	22.98	7.27	0.0	0.07	0.06	63.01	99.86
94	0.12	1.17	15.41	27.19	9.6	0.0	0.0	0.0	46.09	99.58
95	0.02	1.54	17.49	24.23	13.05	0.0	0.0	0.0	43.34	99.67
96	0.09	0.15	6.98	27.22	6.77	0.0	0.01	0.0	57.59	98.81
97	0.03	0.04	7.46	21.99	9.34	0.0	0.0	0.0	60.81	99.67
99	0.0	1.64	16.58	27.49	11.35	0.0	0.0	0.0	42.71	99.77
100	0.05	2.14	16.79	28.1	11.29	0.0	0.01	0.01	41.6	99.99
101	0.0	0.22	13.10	33.05	6.52	0.0	0.03	0.19	45.94	99.05
102	0.0	0.58	8.17	33.49	10.31	0.01	0.02	0.0	45.93	98.51