BUTTE CREEK FIELD REPORT

By Jeffrey Y. Foley and D. D. Southworth

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U.S. DEPARTMENT OF THE INTERIOR

Donald P. Hodel, Secretary

BUREAU OF MINES

Robert C. Horton, Director

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by Jeffrey Y. Foley[1] and D. D. Southworth[2]

ABSTRACT

The Bureau of Mines examined reported PGM-bearing ultramafic rocks near Butte Creek, in eastern Alaska. The investigation was performed as part of the Bureau's assessment of critical and strategic minerals in Alaska. Petrographic studies, in conjunction with geochemical analyses of platinum, palladium, cobalt, copper, and nickel in both rock and panned concentrate samples, were used to determine mineral associations and to evaluate the economic potential of the occurrence. The average platinum and palladium content of the ultramafic rocks collected at the Butte Creek occurrence are 0.004 oz/ton Pt and 0.0012 oz/ton Pd. The overall low grade of the rock samples, combined with the low tonnages to be expected from an apparently small, narrow, sill-form intrusive body render the occurrence subeconomic at this time. The platinum minerals sperrylite ($PtAs_2$) and ferroplatinum alloy were identified in panned and sluiced heavy-mineral concentrates from alluvium, and pan concentrate samples collected from several of the streams draining the biotite clinopyroxenite unit contain up to 0.30 oz/ton combined Au, Pd, and Pt. One sluice box sample contaned 3.4 oz/ton combined Au, Pd, and Pt (2.054 oz/ton Au, 0.491 oz/ton Pd, and 0.853 oz/ton Pt).

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INTRODUCTION

The uses of the platinum-group metals (platinum, palladium, rhodium, iridium, ruthenium, and osmium) are primarily related to their chemical and physical properties of inertness and high melting point and to their extraordinary catalytic activity. The United States produces less than 1 percent of its annual consumption of the platinum-group metals (PGM). Another 15 percent is produced through domestic recycling of scrap. The United States must therefore rely on imports to supply nearly 85 percent of its annual platinum-group metals consumption. Most imports (as of 1983) are from the Republic of South Africa (56 percent of total imports), the U.S.S.R. (16 percent of total imports) and Canada (11 percent of total imports). The dependence on foreign sources for these metals, which have important military as well as vital industrial applications, make them of strategic importance.

As part of its current Alaska-wide assessment of critical and strategic minerals, the Bureau examined a small ultramafic body in eastern Alaska that was reported (3)[3] to contain anomalous levels of platinum and palladium. This report summarizes the results of field investigations conducted by D. D. Southworth and James C. Barker (Bureau of Mines, Fairbanks) during portions of the summers of 1981, 1982, and 1985.

[3] Underlined numbers in parentheses refer to items in the list of references at the end of this report.

GEOGRAPHIC AND GEOLOGIC SETTINGS

The study area (fig. 1) is located in the Yukon-Tanana Uplands, about 46 miles west-southwest of the village of Eagle. These uplands are a

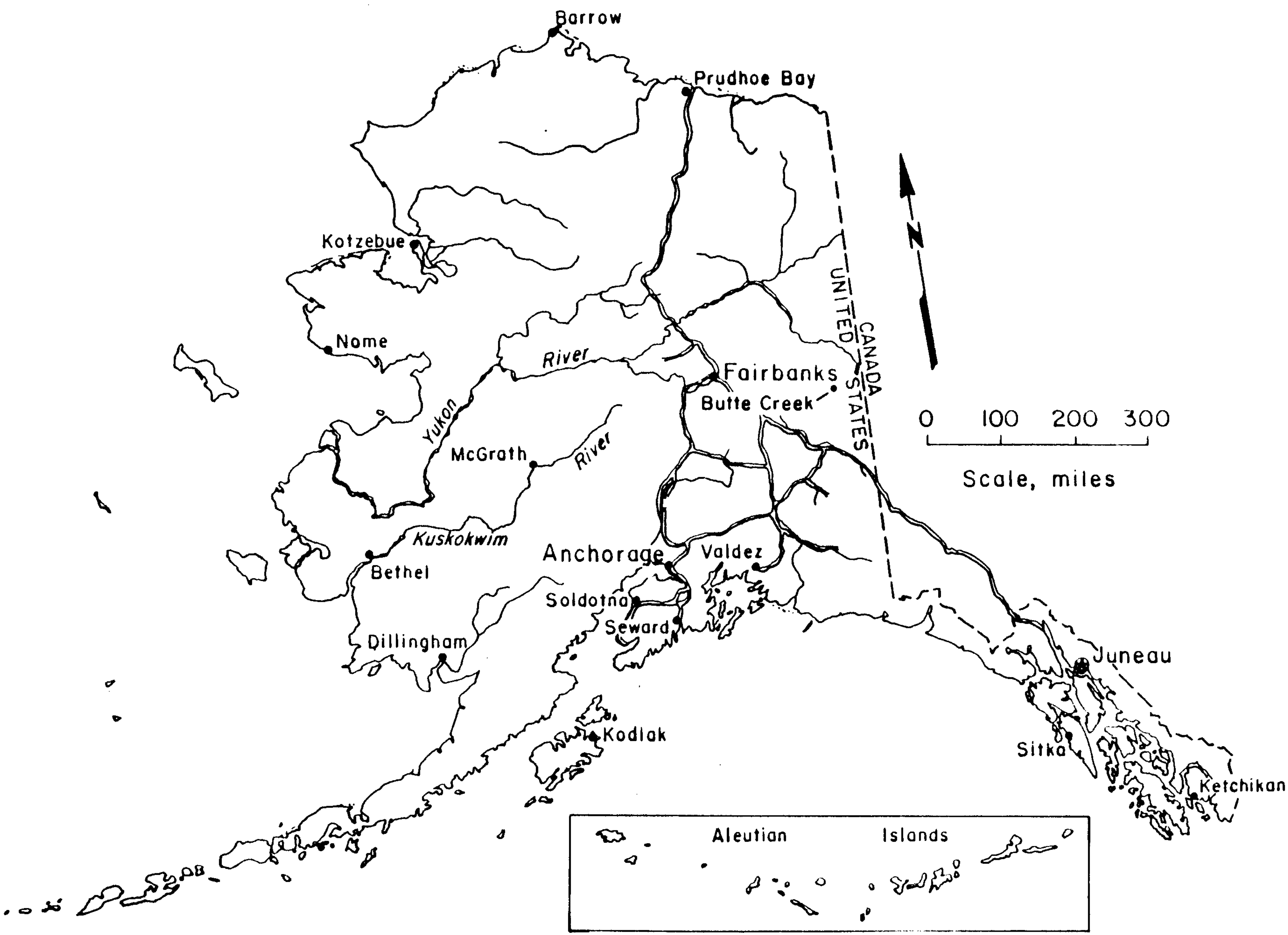


FIGURE 1. - Location map

physiographic province that lies between the Yukon and Tanana Rivers (1-2). The Yukon-Tanana province is characterized by mature streams draining rounded hills and mountains. All of the streams that drain the study area are tributary to the Fortymile River and, eventually, the Yukon River.

The northwest-trending Tintina Fault system, a major structural feature in Alaska, occurs immediately to the north of the Yukon-Tanana Uplands. The Butte Creek occurrence is one of more than 97 separate bodies of ultramafic rock in the Eagle quadrangle that occur in a northwest-trending belt adjacent to and roughly paralleling the Tintina Fault (4). Foster and Keith (3, p. 657) suggested that the Tintina Fault system may have provided a zone of weakness along which mantle material was tectonically emplaced, probably in late Paleozoic time. The Tintina Fault system separates the Paleozoic(?) metamorphic (mostly greenschist facies) rocks that underlie the Yukon-Tanana Upland from the relatively unmetamorphosed, Precambrian to Mesozoic sedimentary rocks to the northeast (Foster, 1976). Within the map area the Paleozoic(?) metamorphic rocks have been intruded by Mesozoic(?), coarse-grained hornblende granodiorite that forms prominent tors along some of the ridges. The hornblende granodiorite may be similar in age to the biotite-clinopyroxenites and hornblende-clinopyroxenites that are the subject of this report. Foster (2) and Keith (4) reports K-Ar ages of 170.7 m.y. (on hornblende) and 180.9 m.y. (on biotite) for similar hornblendites and pyroxenites on Joseph Creek, although the intrusives in the present study area may be of several different ages and unrelated to the dated rocks.

SAMPLING AND ANALYTICAL PROCEDURES

Pan concentrate samples were collected to enhance recognition of platinum and gold. Generally, these metals are not present in sufficient concentrations to be easily detected in stream sediment or rock samples. The pan samples were collected with a steel shovel from the silty, poorly sorted material in the active channel. A 14-in pan was filled with screened (approximately 0.25-in-mesh) material, panned to about a 40-gram sample, and washed into a plastic bag. Most pan samples consisted of 1 to 3 pansful of screened material. In addition, two sluice box samples (EA18579P and EA18597P) were collected. The material washed through the sluice was similar in size and type to the pan concentrate samples, but the sluiced samples were somewhat larger in volume: EA18579P represents 10 gallons of screened material and EA18597P represents 25 gallons of screened material.

Pan concentrate and sluice box samples were further reduced in Fairbanks on a "Super Panner"[4] washing table until each sample approximated 30 grams in weight. Samples were preconcentrated by fire assay procedures at the Bureau's Juneau facility before being analyzed by inductively coupled plasma analysis (ICP) at the Bureau's Reno Research Center.

Stream sediment samples were collected in conjunction with the pan concentrate and sluice box samples. Stream sediment samples were collected with a steel shovel from the finer sandy portion of the active channel. Organic-rich material was avoided. Samples were

[4]Reference to specific products does not indicate endorsement by the Bureau of Mines.

placed in water-resistant paper sample bags and air-dried before screening at 80 mesh. Stream sediment samples were analyzed by TSL Laboratories of Spokane, Washington for cobalt, copper, lead, molybdenum, and zinc by standard atomic absorption procedures.

Rock samples were usually collected as random chip samples across a geologic unit of interest, however, due to the extensive vegetation cover and lack of outcrop, a number of individual grab samples of rubcrop and bedrock were also collected. Rock samples typically weighed from 1 to 3 pounds.

A pulverized fraction of each crushed rock sample was analyzed by standard atomic absorption methods for cobalt, copper and nickel. Following fire assay preconcentration, platinum and palladium were analyzed by ICP analysis. Minimum detection limits for platinum and palladium were 50 ppb and 5 ppb, respectively. The rock sample analyses were performed by Bondar-Clegg Laboratories of Lakewood, Colorado.

LOCAL GEOLOGY

Within the study area (fig. 2) the most abundant intrusive rock is a medium- to coarse-grained hornblende granodiorite. The hornblende granodiorite forms prominent tors along many of the ridges in the area, and several of these tors dominate the top of the hill (elevation 3,820 ft) which is the focus of this study. A coarse-grained biotite clinopyroxenite containing sparsely disseminated sulfide minerals (pyrite and pyrrhotite) intrudes the hornblende granodiorite just below the summit of hill 3820. The biotite clinopyroxenite was suspected to be the source of anomalous PGM detected in pan concentrate samples from the neighboring creeks.

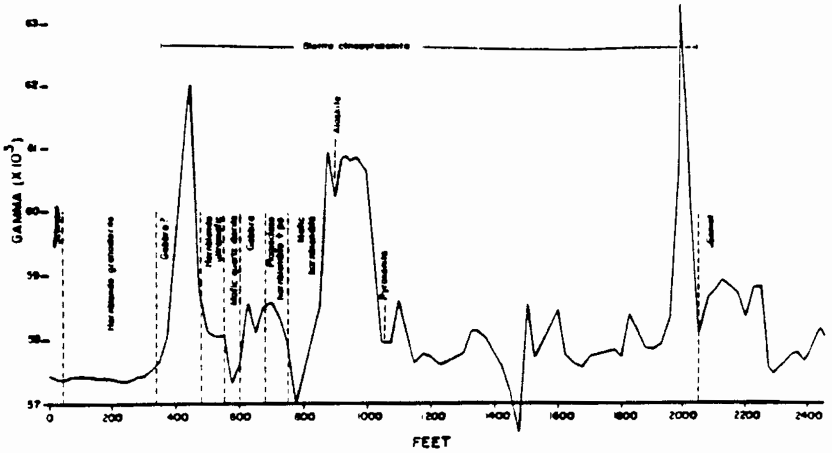
Analyses of samples of biotite clinopyroxenite confirmed the presence of anomalous levels of Pt and Pd.

In 1985, approximately 20 man days were spent mapping the physical extent of the biotite clinopyroxenite unit and collecting additional geochemical rock samples. In addition, since the clinopyroxenite generally contains accessory disseminated magnetite, several magnetometer lines were run to trace the clinopyroxenite in covered areas.

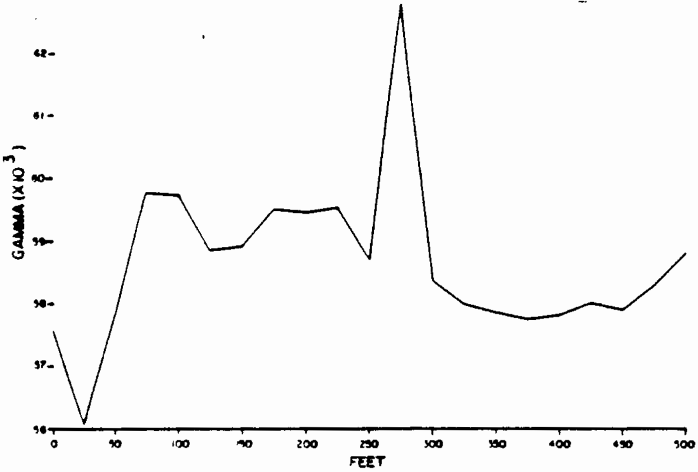
Biotite clinopyroxenite was encountered in a half a dozen outcrops scattered along the slope of hill 3820 for approximately two miles. One 2,400-ft-long and several short (275- to 500-ft) magnetometer lines (figs. 2 and 3) run a half mile east of the peak of hill 3820 indicate that there the biotite clinopyroxenite is a shallow, tabular body. Because of poor exposure, erratic high magnetometer readings could not be correlated with distinct litholigic changes in the ultramafic body. Correlation was attempted by plotting the observed rock types along line A (fig. 3), but magnetic anomalies do not correspond to lithologic changes in all cases. The observed magnetic intensity does decrease at the contact between the hornblende granodiorite and the biotite clinopyroxenite. Magnetometer lines B-D (figs. 2 and 3) are within the area underlain by biotite clinopyroxenite. The biotite clinopyroxenite is probably continuous between the scattered outcrop exposures and as such is believed to represent a small, sill-like body roughly 100 ft thick, striking northeast and dipping moderately to the northwest.

GEOCHEMISTRY

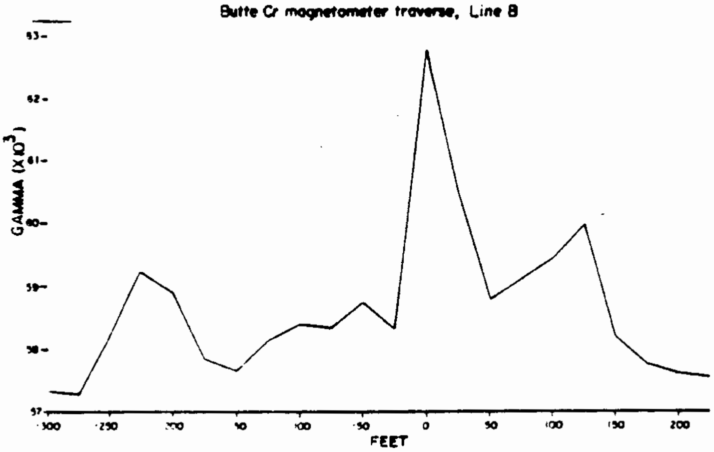
Two concentrate samples (EA18813 and EA18597, table 1) were examined



Butte Cr. magnetometer traverse, Line A



Butte Cr magnetometer traverse, Line B



Butte Cr magnetometer traverse, Line C + D

FIGURE 3. - Magnetometer survey lines.

TABLE 1. - Analytical results[1] of pan concentrate and sluice samples

Sample No.	Au (oz/ton)	Pt (oz/ton)	Pd (oz/ton)
EA 16654[2]	<0.0004	<0.002	<0.002
EA 16656	.026	<.0009	<.0009
EA 16796	.014	<.0003	<.0003
EA 17122	.294	.003	<.0003
EA 17123[2]	<.0002	<.0003	<.0003
EA 17125[2]	<.0002	.002	<.0003
EA 17125[2]	.018	<.0003	<.0003
EA 17126[2]	.046	<.0005	<.0005
EA 18579[2]	2.054	.491	.853
EA 18581	.028	<.01	<.01
EA 18583	.021	.156	.010
EA 18597[2]	.148	.148	.026
EA 18597[2]	.079	.212	.041
EA 18599	.272	.017	<.003
EA 18608	.002*	<.008	<.008
EA 18610	<.0009	<.004	<.004
EA 18812	<.0002	.001	<.0003
EA 18813[2]	.001	<.002	<.002
EA 18814	<.0002	.0003	<.0003
EA 18815	.004	<.0003	<.0003
EA 18816	<.0002	.0003	<.0003
EA 18817	<.0002	<.0003	<.0003
EA 18899	<.0002	<.0003	<.0003
EA 18900[2]	.003	.019	<.002
EA 19347	<.0002	<.0003	<.0003
EA 19349	.003	<.0003	<.0001

*Value at or near detection limit.
[1]Analyses performed by the Bureau's Reno (NV) Research Center.
[2]Sluice box sample.

by scanning electron microprobe at the Reno Research Center prior to fire assay. The platinum mineral sperrylite ($PtAs_2$) was identified in sample EA18813, and a ferroplatinum alloy was identified in sample EA18597. The grains were about 120 micrometers long and 4 micrometers long, respectively.

Analyses of pan concentrate and sluice box samples (table 1) reveal the presence of Pt and Pd in 10 of 26 samples. The highest value obtained (1.34 oz/ton combined Pt and Pd and 2.054 oz/ton Au) was from sluice box sample EA18579, which represents the concentrate from 10 gallons of minus 0.25-in material dug from a cutbank. Sluice box sample EA18597 contained 0.253 oz/ton combined Pt and Pd and 0.079 oz/ton Au. Pan concentrate sample EA18583 contained 0.156 oz/ton combined Pt and Pd and 0.021 oz/ton Au. The highest Au content of the panned concentrates collected was in sample EA18599, which reported 0.272 oz/ton Au, with 0.020 oz/ton combined Pt and Pd. Sample EA18599 represented one 14-in-diameter goldpanful of minus 0.25-in material screened from an original volume of 2.25 pansful.

Analyses of stream sediment samples (table 2) does not indicate anomalous or unusual levels of either Cu, Pb, Zn, Mo, or Co.

Of the rock samples analyzed (table 3), 30 were samples of biotite clinopyroxenite and 14 of the 30 contained detectable Pt or Pd. The two samples highest in combined Pt and Pd (EA16799 and EA23226) were both collected from the same knoll, 0.5 mile to the east of the summit of hill 3820. Sample EA16799 was a single grab sample that contained 0.012 oz/ton combined Pt and Pd. Sample EA23226 was a composite sample of 2-inch chips collected approximately every 5 to 6 ft along the 35- to 40-ft-length of outcrop, and it contained 0.016 oz/ton combined Pt and Pd.

TABLE 2. - Analytical results[1] of stream sediment samples

Sample No.	Cu, ppm	Pb, ppm	Zn, ppm	Mo, ppm	Co, ppm
EA 18577	17	7	49	<2	14
EA 18578	16	11	97	<2	23
EA 18580	26	14	73	<2	16
EA 18582	43	9	83	<2	21
EA 18584	117	8	105	<2	14
EA 18595	10	18	56	<2	14
EA 18596	38	14	94	<2	18
EA 18598	24	13	135	<2	19
EA 18607	17	23	110	<2	18
EA 18609	14	18	84	2	16
EA 18611	16	13	98	<2	18

[1]Analyses performed by Bondar-Clegg Laboratories, Inc., Lakewood, CO.

None of the rock samples analyzed contained significant levels of As, Co, Hg, Mo, Ni, Pb, Sb, W, or Zn. One biotite pyroxenite sample (EA16801) contained 830 ppm Cu and 2.3 ppm Ag, but even in combination these elements are not present in an abundance approaching economic interest. Similarly, the highest Au value reported (0.001 oz/ton) is not considered economically significant.

Because PGM are typically nonuniformly distributed in rocks and are sometimes difficult to accurately analyze at concentrations less than 0.01 oz/ton, a 100-lb sample of biotite clinopyroxenite was collected for concentration of heavy minerals prior to analysis. A 13-lb split from sample EA23118 was crushed and pulverized prior to separation of magnetic minerals with a hand magnet.

The magnetic fraction, presumed to be mostly magnetite, weighed 48.0 g and contained 688 ppb (0.0200 oz/ton) Pt and 104 ppb (0.0030 oz/ton) Au (table 4). The Pt and Au content of the magnetic portion of the

TABLE 3. - Analytical results of rock samples

Sample No.	Ag[1] ppm	As[1] ppm	Au[2] oz/ton	Co[1] ppm	Cu[1] ppm	Hg[1] ppb	Mo[1] ppm	Ni[1] ppm	Pb[1] ppm	Pd[2] oz/ton	Pt[2] oz/ton	Sb[1] ppm	W[1] ppm	Zn[1] ppm	Description
EA 16797			0.0002							<0.0003	<0.0003				"Plagioclase hornblendite".
EA 16798			<.0002							<.0003	<.0003				Do.
EA 16799			<.0002							.004	.008				Hornblende-biotite-pyroxenite.
EA 16800			<.0002							<.0003	<.0003				Hornblende gabbro.
EA 16801	2.3		<.0004	15	830					.002*	.001*		6	16	Biotite-pryoxenite.
EA 16802			<.0002							<.0003	<.0003				Biotite clinopyroxenite.
EA 16810			<.0002							<.0003	<.0003				Quartz vein.
EA 16811			<.0002							<.0003	<.0003				Biotite pyroxenite.
EA 16812			<.0002							<.0003	<.0003				Do.
EA 16813			.001							<.0003	<.0003				Do.
EA 16814			<.0002							<.0003	<.0003				Do.
EA 16815			<.0002							<.0003	<.0003				Do.
EA 16816			<.0002							<.0003	<.0003				Do.
EA 16817			.0002							<.0003	<.0003				Float biotite pyroxenite.
EA 17120			<.0002							<.0003	<.0003				Granodiorite.
EA 17124	0.7		<.0004	31	490					<.0006	<.0006		80	118	Skarn(?) float.
EA 18592	<0.1		<.0002	30	3		<2		8	<.001	<.004			82	Biotite-pyroxenite.
EA 18593	<0.1		<.0002	2	17		<2		5	<.001	<.001			52	Schist.
EA 18594	<0.1		<.0002	23	62		<2		22	<.001	<.001			58	Fine-grained serpentinite.
EA 18602	0.6		<.0002	25	85		<2		8	<.001	<.001			51	Hornblende-granodiorite.
EA 18612	0.2		<.0002	17	84		<2		6	<.001	<.001			32	Ultramafic.
EA 18898	0.5		<.0002	41	141					<.0003	<.0003		3	39	Biotite-pyroxenite.
EA 19338		3	<.0002			40				<.0003	<.0003				Pyroxenite hornblendite with trace pyrite.
EA 19339			<.0002							<.0003	<.0003				Hornblende-gabbro.
EA 19340			<.0002							<.0003	<.0003				Hornblende-granodiorite.
EA 19341			<.0002							<.0003	<.0003				Do.
EA 19342			<.0002							<.0003	<.0003				Biotite-pyroxenite.
EA 19343		3	<.0002			25				<0.001	<0.001				Biotite-pyroxenite.
EA 19344			<.0002							<.0003	<.001				Fine-grained biotite-pyroxenite.

See notes at end of table.

TABLE 3. - Analytical results of rock samples--Continued

Sample No.	Ag[1] ppm	As[1] ppm	Au[2] oz/ton	Co[1] ppm	Cu[1] ppm	Hg[1] ppb	Mo[1] ppm	Ni[1] ppm	Pb[1] ppm	Pd[2] oz/ton	Pt[2] oz/ton	Sb[1] ppm	W[1] ppm	Zn[1] ppm	Description
EA 19345		3	<.0002			40						<2			Coarse-grained biotite pyroxenite.
EA 19346		3	<.0002			20				<.0003	<.0003	2*			Do.
EA 19348a		3	<.0002			25				.001*	.001	2*			+80 mesh soil.
EA 19348b		4				25						2*			-80 mesh soil.
EA 23111															Aplite.
EA 23112															Hornblende diorite.
EA 23113															Do.
EA 23114															Aplite.
EA 23115										65[3]	90[3]				Biotite-pyroxenite.
EA 23116				46	265			69		5[3]	<50[3]				Hornblende granodiorite.
EA 23117A										5[3]	<50[3]				Hornblende-biotite-clino-pyroxenite.
EA 23117B															Hornblende diorite.
EA 23214										70[3]	170[3]				Hornblende-clinopyroxenite.
EA 23215										10[3]	<50[3]				Biotite-pyroxenite.
EA 23216										<5[3]	<50[3]				Do.
EA 23217										15[3]	65[3]				Hornblende-biotite-clino-pyroxenite.
EA 23218															Pyroxenite xenolith in granitic.
EA 23219				42	90			46		<5[3]	<50[3]				Do.
EA 23220				9	31			10		<5[3]	<50[3]				Soil: biotite-pyroxenite.
EA 23221				20	21			45		15[3]	90[3]				Do.
EA 23222				35	104			49		35[3]	75[3]				Biotite-pyroxenite soil.
EA 23223				43	50			78		<5[3]	<50[3]				Do.
EA 23224				9	72			3		<5[3]	<50[3]				Hornblende-gabbro.
EA 23225				23	20			14		5[3]	55[3]				Biotite-pyroxenite.
EA 23226				21	9			43		165[3]	405[3]				Do.
EA 23227				8	32			6		<5[3]	<50[3]				Hornblende-granodiorite.

*Value at or near detection limit. NOTE: No data indicates no anlysis.
[1]Analyses by Bondar-Clegg Laboratories, Inc., Lakewood, CO.
[2]Analyses by the Bureau's Reno (NV) Research Center.
[3]Analyses by Bondar-Clegg; results in parts per billion (ppb).

13-lb sample, after multiplying those concentrations by their respective proportions of the larger sample, are 5.5 ppb (0.00016 oz/ton) Pt and 104 ppb (0.03033 oz/ton) Au.

The nonmagnetic balance of the 13-lb sample was then panned to produce a 48.1-g nonmagnetic heavy mineral concentrate and the tailings were archived. That 48.1-g concentrate was further panned, producing a 4.1-g concentrate and 44 g of tailings. Both the concentrate and the tails, in this case, were submitted for analysis (table 4).

The 44 g of tailings (EA23118B) from the 48.1-g, nonmagnetic, heavy mineral concentrate contained 91 ppb (0.00265 oz/ton) Pt and 704 ppb (0.02054 oz/ton) Au. Back-calculation on the basis of the 13-lb original sample weight yields 0.7 ppb (0.00002 oz/ton) Pt and 5.2 ppb (0.00015 oz/ton) Au.

The 4.1-g, nonmagnetic concentrate (EA23118C) contained 700 ppb (0.020 oz/ton) Pt and 33,196 ppb (0.968 oz/ton) Au. Calculating on the basis of the 13-lb weight, these values correspond to 0.48 ppb (<0.00001 oz/ton) Pt and 22.7 ppb (0.00066 oz/ton) Au.

An estimate of the total Pt and Au recovered by panning the original 13-lb sample is obtained by adding the Pt and Au contents of the various fractions as shown in table 4. These values (1,479 ppb Pt and 34,004 ppb Au) correspond to 0.0431 oz/ton Pt and 0.9914 oz/ton Au.

TABLE 4. - Analytical results, ppb, of heavy mineral fractions from biotite clinopyroxenite sample EA23119

Sample	Au	Pd	Pt	Description
EA23118A	104	NIL	688	48-g magnetic concentrate.
EA23118B	704	NIL	91	44-g panned nonmagnetic tailings.
EA23118C	33,196	NIL	700	4.1-g panned nonmagnetic concentrate.
TOTAL	34,004	NIL	1,479	Original 13-lb sample (calculated).

Because metallic grains, suspected to possibly be platinum minerals, were observed in 23118C, the sample was examined with a scanning electron microscope. All the metallic grains were identified as zinc, possibly resulting from panning in a galvanized tub. Sulfides of Cu, Fe, Pd, Sb, and Bi were identified. No Au or platinum minerals were observed.

SUMMARY AND RECOMMENDATIONS

A 100-ft-thick sill of biotite-clinopyroxenite intrudes hornblende granodiorite in the eastern portion of the Eagle (C-3) quadrangle, Alaska. The sill is roughly two miles long; it strikes northeasterly and dips moderately to the northwest. Clinopyroxenite samples from this sill contain up to 0.016 oz/ton combined Pt and Pd.

Pan concentrate and sluice box samples collected from streams draining the clinopyroxenite contain up to 0.30 oz/ton combined Au, Pd, Pt.

Because of the nonuniform PGM distribution, and overall low PGM grade of the biotite clinopyroxenite sill and surrounding streams, no further work by the Bureau is recommended.

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00	1130	57710	coarse grain bio pyroxenite	OC
25	1131	57616	" felds dike	OC
50	1132	57669	w/ felds dikes	OC - Top of kn
75	1132	57700	"	OC
+00	1134	57793	"	no OC
-25	1135	58154	"	no OC
-50	1135	58131	"	no CC
-75	1136	58020	fine-med grain bio pyroxenite rubble	
+00	1137	57666	?	
+25	1138	57535	?	
+50	1139	57135	?	
+75	1140	56525	?	
00	1141	58560	grd flt a few chips - red soil	
-25	1142	57730	break in slope	
-50	1143	57970	?	
+75	1144	58210	?	
+00	1146	58458		
+25	1147	57880	coarse grain plag hornblendite w/ pyrrhotite	
+50	1148	57623	?	
+75	1148	57590	?	
+00	1149	57739	?	
-25	1151	57774	?	
+50	1152	57814	?	
+75	1153	57843	?	
-00	1154	57753	?	
25	1155	58410	?	

STA	TIME		Geol	
6+25	1027	58585	?	
6+50	1028	58104	?	
6+75	1030	58514	plag hbd w/ pyrrhotite	
7+00	1031	58591	"	
7+25	1032	58357	"	
7+50	1033	57724	mafic hbd grd w/ pyrr	
7+75	1033	57020	plag por hbd grd	
8+00	can't get a reading - wild variation up to			
8+25	1044	58125	?	
8+50	1046	58535	?	
8+75	1049	60960	?	
9+00	1052	60250	Alaskite rubble + fine gra	
base	1054	59440		
base	1115	59466	?	
9+00	1117	60300	?	
9+25	1118	60962	?	
9+50	1119	60824	?	
9+75	1120	60866	bio hbd per	
10+00	1121	60656	?	
10+25	1122	59148	?	
10+50	1124	57978	bio (± por bio) ± plag pyroxenite	
10+75	1124	57984	"	
11+00	1125	58602	"	break slo
11+25	1126	58070	"	
11+50	1127	57648	"	O.C.
11+75	1128	57795	"	

18+50	1156	58169	?
18+75	1156	57866	?
19+00	1157	57860	?
19+25	1158	57912	swallet on slope to OC, to south ~ 100 yds
19+50	1158	58350	
19+75	1159	60698	?
20+00	1200	63533	?
20+25	1202	60150	?
20+50	1204	58090	?
20+75	1205	58645	?
21+00	1205	58780	?
21+25	1207	58943	?
21+50	1207	58848	?
21+75	1208	58735	?
22+00	1208	58354	
22+25	1210	58221	
22+50	1210	58023	
22+75	1211	57542	
23+00	1213	57567	
23+25	1213	57605	
23+50	1214	57793	
23+75	1215	57769	
24+00	1216	57876	
24+25	1217	58092	
24+50	1217	58064	
base	1240	59475	✓

SW FROM STA (275) of LINE B

	Reading
5	628
5	605
[illegible]	58790
5	59035
[illegible]	59435
5	(600)
50	58244
75	57793
00	57649
25	57640
50	58779

NE of STA (275) of Line B

[illegible]	58326	[illegible]	[illegible]	57351
[illegible]	58738			
5	58347			
[illegible]	58406			
[illegible]	58153			
[illegible]	57653			
75	57876			
[illegible]	57725			
[illegible]	57265			
	55191			
[illegible]	57[illegible]			

LINE B. 7/22/65

[illegible]	[illegible]	57347 57539 57626	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	75	[illegible]	
[illegible]			
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	225	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	([illegible])	([illegible])	AT Rise in slope up to RIDGE AT CAMP
4:10	50 SW of 275	58797	
4:11	10' NE of 275	61486	
4:12	300	58379	
4:13	325	58009	
4:16	350	57873	
4:17	375	57753	
4 18	400	57820	
4:19.30	425	58010	
4:21	450	57910	
4.22	475	58304	
4:23.30	500	58817	

[redacted]