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INVESTIGATION OF A COPPER OCCURRENCE IN THE RAMPART DIORITES

By

Mark M. McDermott
Jeffrey Y. Foley
Dennis D. Southworth

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NITED STATES DEPARTMENT OF THE INTERIOR

ames G. Watt, Secretary

UREAU OF MINES

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ABSTRACT

During the 1976 through 1979 field seasons the Bureau of Mines made mineral evaluation studies of the Trans-Alaska Pipeline Corridor for the Bureau of Land Management. Part of the work was done under contract by the University of Alaska, Mineral Industry Research Laboratory (MIRL). In 1977 MIRL reported a body of hornblende diorite in the Rampart Group south of Hess Creek in the Livengood Quadrangle that locally contained as much as 10 percent sulfide. In 1979 the U. S. Bureau of Mines used a combination of geological, geophysical and geochemical methods to evaluate the potential of this area for porphyry type copper deposits. Low concentrations of copper were found as minor occurrences in small diorite dikes and sills. The low concentrations found and the low tonnages implied by this mode of occurrence suggest that in this area the Rampart Group assemblage has little potential for porphyry copper type deposits.

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ACKNOWLEDGEMENTS

All of the samples discussed in this report, except for pan concentrates, were analyzed under a grant from the U. S. Department of Energy to the Los Alamos Scientific Laboratory, New Mexico. Analyses were made of 46 elements including uranium and thorium by a combination of x-ray fluorescence and neutron activation methods. Their results and procedures will be concurrently open-filed by the Department of Energy. Pan concentrate analyses were performed by Skyline Labs, Inc. of Wheat Ridge, Colorado using optical emission spectroscopy.

Base maps used in this report are adapted from standard U. S. Geological Survey quadrangle maps of the area. Geologic maps are adapted from the Preliminary Geologic Map of the Livengood Quadrangle, Alaska by Robert M. Chapman, Florence R. Weber and Bond Taber 1971, USGS Open File Map 483 (3) 4/.

INTRODUCTION

During the 1976-78 field seasons the University of Alaska Mineral Industry Research Laboratory (MIRL) conducted the initial work on a mineral evaluation study of the Trans-Alaska Pipeline Corridor. Among their findings they reported a mineralized hornblende-diorite sill-like body, containing as much as 10 percent sulfides, located just south of Hess Creek in the Livengood quadrangle (figs. 1 & 2). One sample of diorite from this body contained 0.28 percent copper. MIRL concluded that "the occurrence of porphyry-type mineralization in rocks of the Rampart Group indicated that the terrane may have good mineral potential and may contain porphyry-type deposits" (Robinson and Metz, 1979)(4).

4/ Numbers in parentheses refer to references listed at the end of the report.

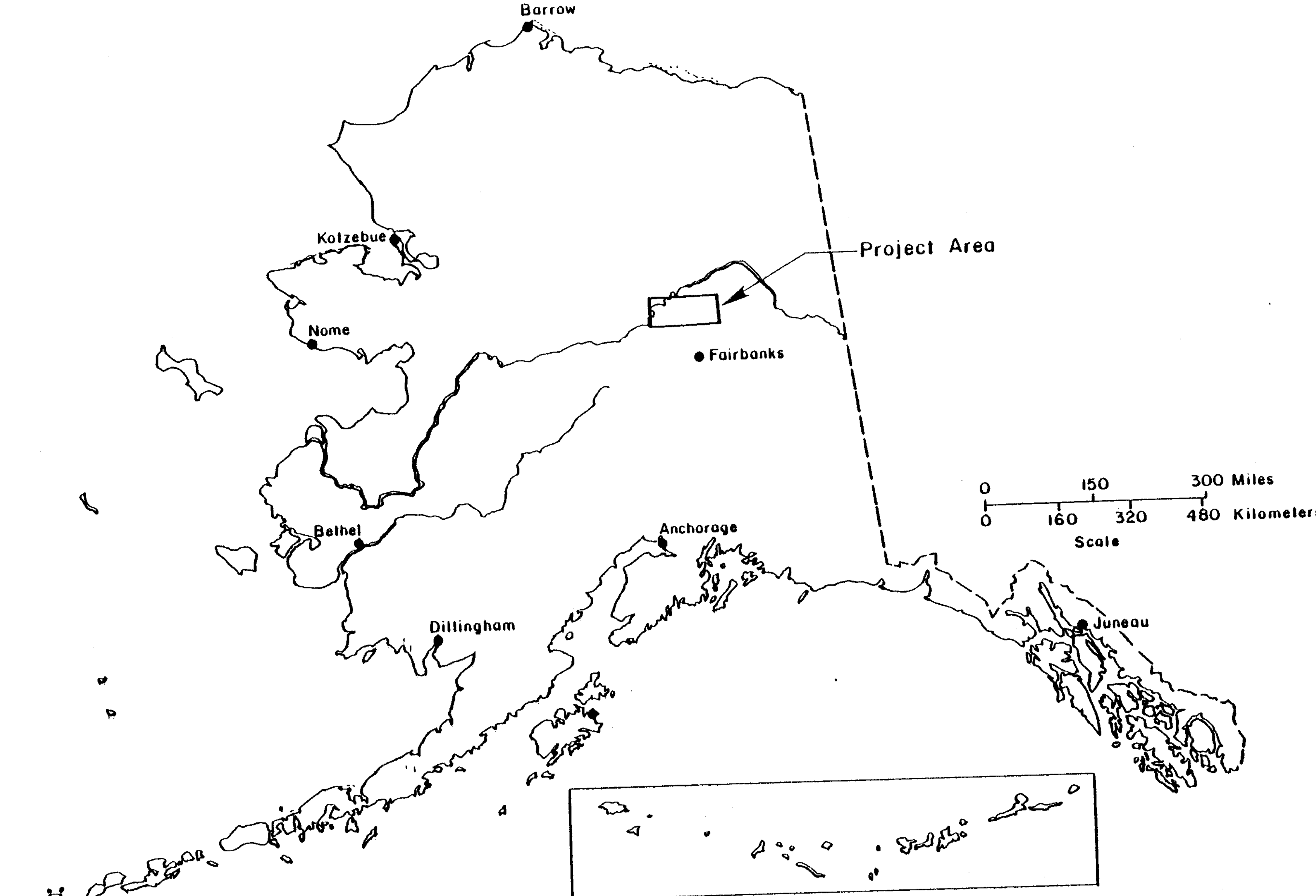
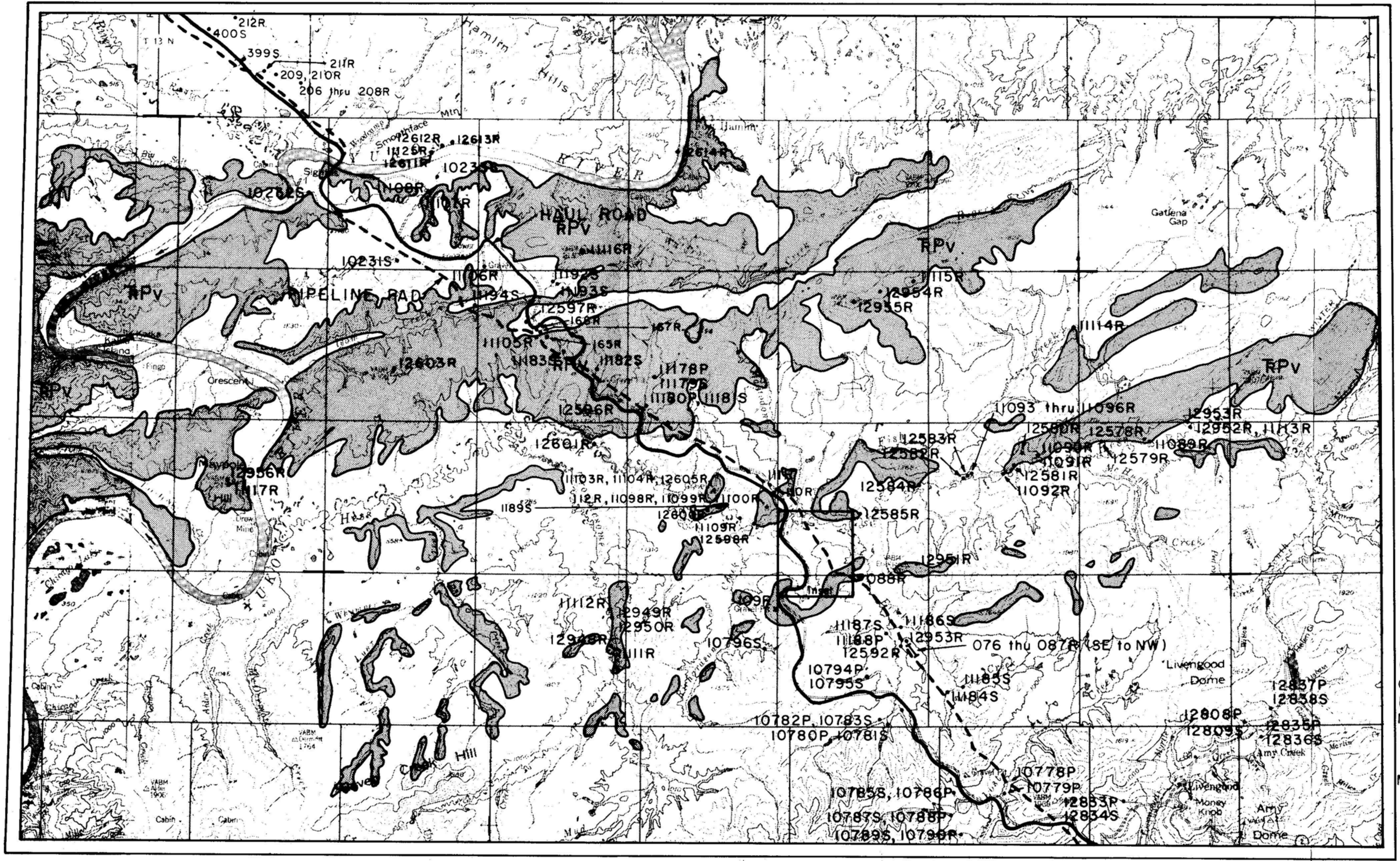


Figure 1.— Project location map



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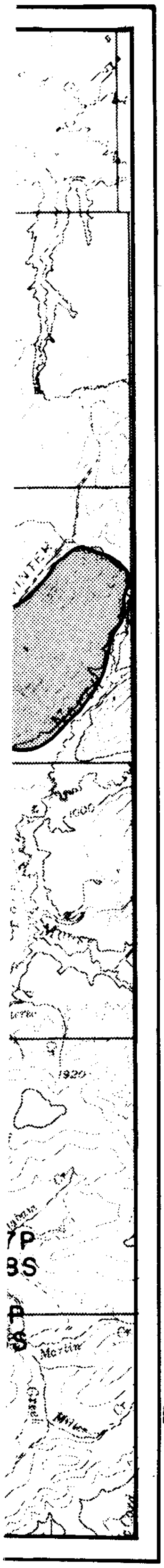
Geology ada
Quadrangle,
Bond Taber
Mark McDerm

Map Area Ta

RAMPART GROUP ROCKS AND SAMPLE LOCATION MAP



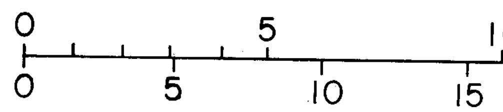
LEGEND

RPv	Rampart Group Extrusive and Intrusive Mafic Rocks, With Some Undifferentiated Sedimentary Rocks

Sample Types

R = Rock
S Stream Sediment
P = Pan Concentrate

•12525R – Sample Location and Type. Letter Suffix With Sample Number Denotes Sample Type. (See Above List)



Scale

Geology adapted from Preliminary Geologic Map Of The Livengood Quadrangle, Alaska by Robert M. Chapman, Florence R. Weber and Bond Taber 1971, USGS Open File Map 483 (4), with additions by Mark McDermott and Jeff Foley, U S. Bureau of Mines, 1979.

Map Area Taken From Livengood USGS 1:250,000 Scale Quadrangle

FIGURE 2

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As part of the Bureau of Mines Pipeline Project for 1979, this area was investigated further to determine its potential for containing prophyry-copper type deposits.

In fulfilling this objective, the Hess Creek prospect was studied using a combination of geological, geochemical and geophysical methods to determine its major characteristics. If the results were found to be favorable for porphyry mineralization then these data would, a) be compared to known characteristics of porphyry copper deposits in diorites, and b) be used as a guide to locating other possible copper bearing diorite intrusions within the Rampart Terrane.

During the period of June 6 to June 19, 1979, approximately 22 man days were spent on field work related to the diorite intrusives in the Rampart Group. Helicopter support was available for three days.

GEOLOGY

The Rampart Group is mapped by Chapman, Weber, and Taber (1971)(3) as Triassic and Permian extrusive and intrusive mafic rocks with some undifferentiated sedimentary rocks. Brosge, et al (1969)(2) noted that "diabase dikes and larger bodies of gabbro and augite diorite are common within the mapped boundaries of the Rampart Group".

Exposure in the Livengood quadrangle is poor - rarely were more than two outcrops observed within the same diorite body. In some areas, no outcrops are visible, only diorite and chert float along the pipeline pad. Evidence along the pad indicates that the rock forming the pad has been moved around extensively and in many cases has been trucked in from other locations. Geological evidence in some areas is thus largely based on MIRL observations made at the time of trench excavation.

MIRL noted a difference between the sill-like structure of diorite south of Hess Creek and the larger "clearly intrusive forms" north of Hess Creek. Our findings agree with those of MIRL: south of Hess Creek the diorite intrusives are in the form of fine to medium grained sills or dikes measuring up to a few meters in width while north of Hess Creek the diorite generally forms large (hundreds of meters), irregularly shaped intrusive bodies (fig. 2).

Contact relations of the larger diorite intrusions are obscure: the contacts are usually marked by a zone of extensive shearing and alteration. This suggests that faulting was a dominant mechanism of emplacement into their present position. One exception to this is a diorite body exposed along the north side of Hess Creek (Livengood C-4, T.10N., R.5W., Sec. 2). Here the diorite clearly shows an intrusive relationship with bedded chert. The texture of the diorite becomes progressively finer grained within 15 to 30 meters (50 to 100 ft.) of the chert, suggesting a chilled border zone. In addition, finer grained dikes (approximately a meter in width) of dioritic composition intrude the chert and appear to be genetically related to the larger diorite body. This location is also significant in that it is one of the very few places that copper minerals were seen in hand specimen. A few blebs of chalcopyrite were noted in the diorite (?) and malachite coated fractures in the chert over a small area near one of the diorite (?) dikes. This occurrence is similar in general form to the Hess Creek occurrence (Livengood C-5, T.10N., R.7W., Sec. 29) where chalcopyrite is disseminated in a diorite dike, and malachite coats fractures in both the diorite (?) and chert country rock (12640R).

PETROGRAPHY

The mafic intrusive rocks of the Rampart Group in the study area include diorites and gabbros. Textures range from fine grained, hypidiomorphic to coarse grained hypidiomorphic. Plagioclase typically forms euhedral laths and generally has altered cores of sericite, kaolin and dusty inclusions of quartz and epidote. Mafic minerals present include augite and minor hornblende. These are frequently chloritized and the pyroxene commonly bears vermicular growths of exsolved titanite which preferentially grows along cleavage planes of the silicate phase. Other opaques include magnetite, pyrrhotite, pyrite and, rarely, chalcopyrite. Common accessories include apatite and sphene. The more extensively altered diorites and gabbros frequently contain coarse, twinned interstitial carbonate mineral(s).

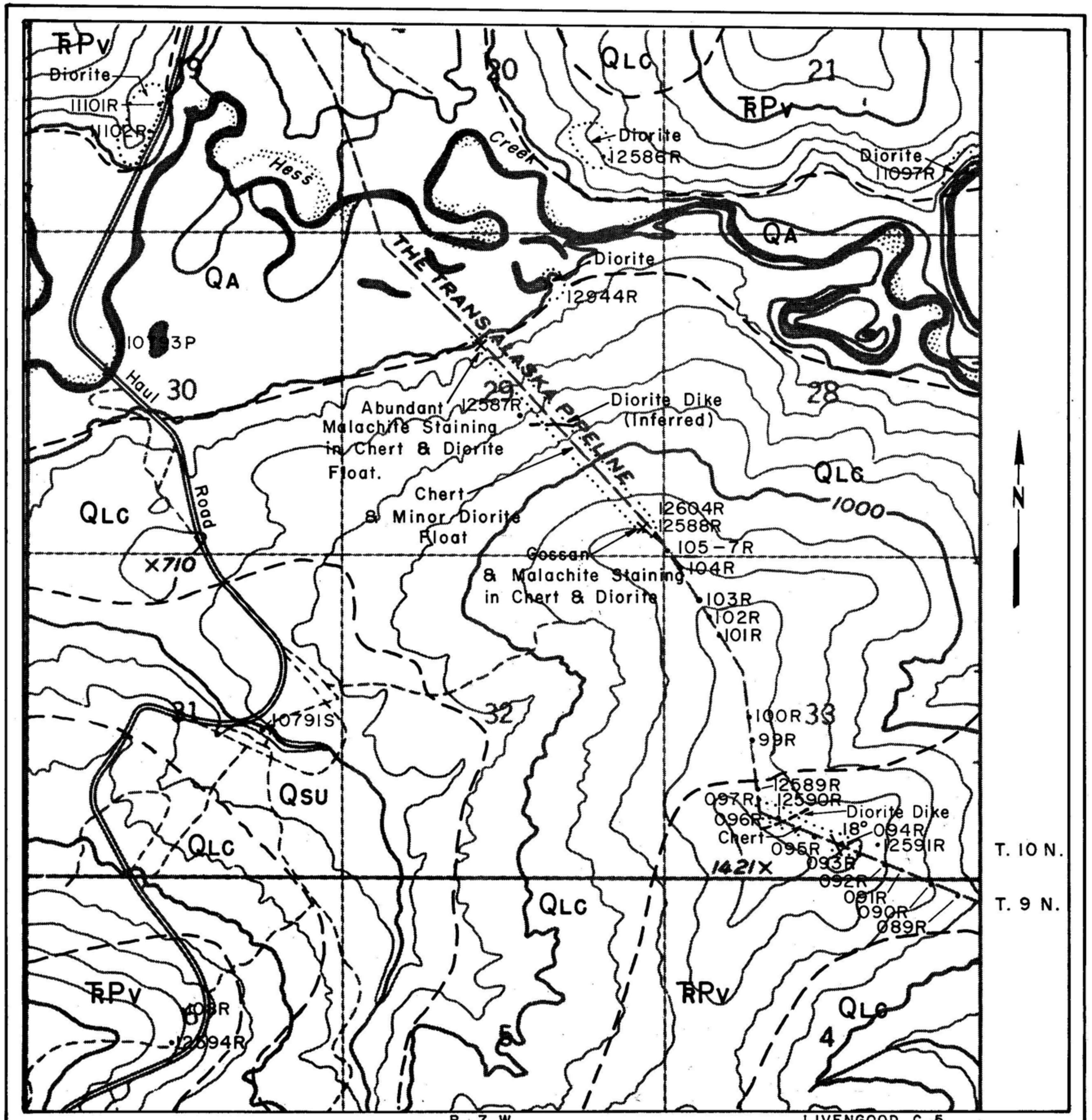
MAGNETOMETER SURVEYS

Due to the lack of visible outcrop, an alternative method was sought for mapping diorite along the hillside in the vicinity of the Hess Creek occurrence (fig. 3). Because of the high magnetic contrast of magnetite-rich diorite and the chert country rock, several magnetometer survey lines were run parallel to the pipeline (fig. 4). In general the magnetic character of the rocks in the area were very uniform, varying only 30 gammas over several hundreds of meters. This is the result expected from an area underlain almost entirely with chert. One dike, due to its distinctly higher magnetic signature, was located by this method. Detailed magnetometer lines revealed that the dike is striking nearly normal to the pipeline.

SOIL GEOCHEMISTRY SURVEY

Soil geochemistry lines were run across the dike located by the magnetometer survey, as well as on the hillside adjacent to the dike (fig. 4).

GEOLOGY AND SAMPLE LOCATION MAP
HESS CREEK AREA



LEGEND

Pleistocene (?) And Holocene — Quaternary

QA — Alluvium

QSU — Silt undifferentiated and Organic Muck

QLC — Loess & Colluvium

Permian & Triassic

TRPv — Rampart Group
Extrusive and Intrusive Mafic Rocks With Some Undifferentiated Sedimentary Rocks

Contact, Approximately Located

Limit of Outcropping Rock

18° Dip & Strike of Bedding

Sample Types

R = Rock
S = Stream Sediment
P = Pan Concentrate

•12525R – Sample Location and Type. Letter Suffix With Sample Number Denotes Sample Type. (See Above List)

0 2000 4000 6000 Feet

0 500 1000 1500 Meters

Scale

Geology adapted from Preliminary Geologic Map Of The Livengood Quadrangle, Alaska by Robert M. Chapman, Florence R. Weber and Bond Taber 1971, USGS Open File Map 483 (4), with additions by Mark McDermott and Jeff Foley, U.S. Bureau of Mines, 1979.

FIGURE 3

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It was hoped that any copper associated with the dike would be present in the soil samples collected during the survey.

SAMPLING AND ANALYTICAL PROCEDURES

General

Approximately 106 rock samples, 55 soil samples, 22 stream sediment samples and 9 pan concentrate samples were collected in and near the diorite intrusive bodies within a portion of the Rampart Terrane. The locations of the rock and stream sediment samples are scattered widely throughout the Livengood C-4 to C-6 and D-4 to D-6 quadrangles (fig. 2). The soil samples, however, were all taken in the vicinity of the reported copper bearing diorite near Hess Creek (fig. 4).

The rock, stream sediment, and soil samples were all analyzed by the Los Alamos Laboratory in New Mexico under a grant from the Department of Energy. Analyses were made of 46 elements by a combination of x-ray fluorescence and neutron activation. Only the results of analyses for Cu, Pb, Zn, As, and Ti however, are listed in this report (Tables 1-3). It is recommended that the reader who desires additional geochemical data on the study area refer to the complete geochemical report which is available through the Department of Energy (1).

The pan concentrate samples were analyzed by semi-quantitative optical emission spectroscopy for 31 elements. The analyses were performed by Skyline Labs, Inc. of Wheat Ridge, Colorado. These results are reported in full (Table 4). A visual scan of the data shows no anomalous elemental concentrations of any significance.

TABLE 1: Geochemical analyses of Rampart Group rock samples (reported in ppm)

Sample Number 1/	Copper	Lead	Arsenic	Titanium	Zinc	Description
076BR	247	-5	12	10370	187	Trachyte with calcite veining.
077BR	70	-5	11	9861	-14	Chloritized hornblende diorite.
078BR	28	-5	10	4827	96	Interbedded siltstone and sandstone.
079 R	16	11	7	4126	-36	Sandstone and shale.
080BR	22	13	-5	4647	128	Sandstone with calcite and quartz veining.
081BR	210	-5	6	12840	122	Trachyte.
082 R	58	-5	11	5020	-151	Siltstone.
083BR	87	-5	8	2559	119	Chloritized hornblende diorite with biotite.
084AR	21	-5	9	5361	166	Siltstone with limonite staining.
085BR	166	-5	20	9007	-48	Chloritized diorite.
086BR	84	16	7	2023	238	Siltstone with heavy iron staining.
087BR	154	-5	-5	8828	-55	Chloritized diorite with pyrite.
088BR	184	-5	-5	7720	155	Chloritized diorite.
089BR	122	13	-5	1190	154	Chert and siltstone.
090BR	193	-5	9	8620	-65	Coarse sandstone with iron staining.
091BR	131	-5	-5	2988	-38	Silicified siltstone with limonite staining.
092BR	289	-5	9	6699	229	Silicified sandstone.
093BR	10	-5	-5	10960	225	Chloritized diorite.
094BR	72	-5	12	-1420	114	Siltstone.
095 R	26	-5	-5	11150	-51	Chloritized diorite.
096BR	92	19	-5	1734	-21	Silicified siltstone.
097 R	171	-5	16	6723	191	Silicified siltstone.
099BR	1809	-5	36	12370	146	Silicified siltstone at contact with diorite sill(?).
100BR	46	-5	7	11830	-56	Chloritized diorite.
101BR	84	-5	5	4054	779	Siliceous siltstone.
102BR	83	-5	-5	-693	-89	Chert.

1/ Analyses by Los Alamos Scientific Laboratories, N. M.
AS, Cu, Pb by x-ray fluorescence
Ti, Zn by neutron activation
(-) less than

geochemical analyses of Rampart group rock samples - cont.

Sample Number	Copper	Lead	Arsenic	Titanium	Zinc	Description
103BR	190	-5	6	8348	143	Hornblende diorite with chalcopyrite and pyrite.
104BR	20	-5	-5	9142	149	Chloritized granodiorite with pyrite.
105BR	570	13	-5	6797	112	Hornblende granodiorite with pyrite, chalcopyrite, malachite.
106BR	600	5	79	5262	-5	Chloritized granodiorite.
107BR	4836	15	21	6974	246	Granodiorite with pyrite and chalcopyrite.
108BR	383	-5	24	27210	-58	Chloritized diorite with pyrite.
109BR	67	-5	24	4649	-142	Silicified metasiltstone with pyrite.
110BR	110	-5	-5	5977	-70	Chloritized, biotite diorite with pyrite.
111 R	31	11	11	4407	100	Siltstone.
112BR	336	-5	13	29040	-61	Biotite diorite with pyrite.
165BR	205	-5	15	18930	121	Phyllite.
167BR	28	6	-5	1500	-78	Conglomerate.
168BR	70	-5	27	9592	194	Lithic tuff.
11089 R	157	5	22	8172	-49	Fine grained chloritized diorite. Visible sulfides-chalcopyrite?
11090 R	21	-5	5	9717	146	medium grained hornblende diorite(?) sheared. Calcite veining. Slightly chloritized.
11091 R	84	-5	7	9855	---	Fairly fresh hornblende diorite. Approx. 4% sulfides, pyrite.
11092 R	65	19	24	10850	-61	Very fine grained diorite. Very fresh, approx. 3% sulfides (pyrite).
11093 R	26	-5	13	12070	-54	Taken at fault contact (3' shear zone) between slaty phyllite and highly sheared diorite. Taken from diorite side. Few % pyrite.
11094 R	14	-5	-5	14880	124	Taken near shear zone. Diorite moderately fractured and altered.
11095 R	106	-5	6	7550	88	Medium grained hornblende diorite. Rusty stain from few % pyrite, some chalcopyrite noted.
11096 R	-10	-5	23	11730	110	Medium grained hornblende diorite. Fairly fresh.
11096 R	62	-5	6	9823	129	
11097 R	133	-5	5	13100	-68	Medium grained slightly chloritized hornblende diorite, few % pyrite. No visible Cu.
11098 R	409	-5	16	25250	148	Grab sample from outcrop of sheared, fractured, altered and red stained fine - medium grained hornblende diorite.
11099 R	551	-5	60	11270	145	Rubble crop in pit. Fine - medium grained diorite. somewhat high-grade. Not representative.
11100 R	254	-5	22	10340	-66	Fine - medium grained hornblende diorite, chloritized, approx. 50% mafics, some pyrite.

geochemical analyses of Rampart group rock samples - cont.

Sample Number	Copper	Lead	Arsenic	Titanium	Zinc	Description
11101 R	140	-5	11	6459	-60	Fine - medium grained diorite, fairly fresh sample.
11102 R	149	-5	15	6741	-65	Fine - medium grained hornblende diorite.
11103 R	159	-5	17	21170	-70	Surface float on top of gravel pit. Diorite.
11104 R	147	-5	16	3531	-67	Crumbly red stained diorite at contact with chert. Contact sheared and altered (approx. 5' wide).
11105 R	31	8	11	4555	119	Diorite intruding section of slightly metamorphosed sediments.
11105 R	69	-5	6	11620	-67	Duplicate.
11106 R	36	-5	8	813	-27	Red and green chert in gravel pit. (malachite?).
11107 R	209	-5	23	7658	-68	Gabbro(?).
11108 R	173	-5	-5	7687	123	Fine grained diorite with -1% pyrite. Mafic content approx. 60%.
11109 R	57	-5	17	13860	-59	Diorite.
11111 R	44	7	26	12000	-56	Highly sheared and chloritized hornblende diorite. Small amount of pyrite noted.
11112 R	409	201	-5	15510	-58	Very fine-grained hornblende diorite.
11113 R	192	-5	8	8132	167	Medium grained diorite, few % sulfides, possible chalcopyrite.
11114 R	214	-5	34	7776	---	Medium grained, chloritized diorite.
11115 R	133	-5	13	6632	-59	Medium grained, chloritized hornblende diorite.
11116 R	325	-5	18	11010	-52	Medium grained diorite.
11117 R	55	-5	74	10930	-98	Medium grained, chloritized hornblende diorite. chalcopyrite noted.
11125 R	96	-5	20	9539	-66	Medium grained, chloritized hornblende diorite. Few % pyrite and magnetite.
12578 R	179	-5	13	8049	-65	Mafic volcanics. Trachybasalt/trachyandesite.
12579 R	302	-5	8	12810	-55	Mafic volcanic.
12580 R	85	-5	20	11800	-55	Mafic volcanic.
12581 R	22	12	11	2738	-75	Fine grained green volcanic rock with minor chert. No visible mineralization.
12582 R	178	-5	9	9321	-74	Medium grained green mafic rock. In contact with red-stained chert.
12583 R	213	-5	5	8091	-51	Coarse grained sausseritized diorite. Sulfides include pyrite and minor chalcopyrite.
12584 R	210	-5	5	10840	-49	Fine grained basalt-andesite, some quartz veinlets.
12585 R	25	-5	8	8872	153	Fine - medium grained mafic igneous rock.
12586 R	86	36	5	11800	224	Mafic igneous rock. Some quartz veinlets. Dioritic-gabbroic in composition.
12588 R	191	-5	15	10840	197	Pyrite bearing and leached, iron stained diorite.

geochemical analyses of Rampart group rock samples - cont.

Sample Number	Copper	Lead	Arsenic	Titanium	Zinc	Description
12589 R	60	263	98	10410	514	Phaneritic diorite. Green on fresh surface. Visible magnetite.(sausseritized?).
12590 R	135	-5	19	7289	-12	Diorite.
12591 R	104	-28	105	----	1420	Fractured, iron stained, black and red-brown chert.
12592 R	191	-5	-5	2486	197	Slaty mud-siltstone. Green weathers to brown. Some iron staining.
12593 R	185	6	6	9021	-56	Diorite at fault contact with mudstone (12592R).
12594 R	374	-5	12	19920	212	Diorite with abundant magnetite, minor pyrrhotite; calcite veinlets.
12595 R	227	-5	21	11360	-67	Biotite, hornblende diorite.
12596 R	42	-5	51	14130	150	Fine-medium grained igneous rock. Weathers brown. Spheroidal weathering.
12597 R	77	-5	14	11320	-66	Andesite - basalt with calcite filling amygdules.
12598 R	331	-5	16	11140	-62	Coarse grained hornblende diorite.
12600 R	152	-5	11	6525	-5	Coarse diorite.
12601 R	-10	-5	-5	20840	152	Coarse sausseritized diorite.
12603 R	228	-5	12	8922	-58	Basalt in contact with chert.
12604 R	15605	11	42	-737	330	Green Cu stain on chert.
12605 R	104	71	475	6653	-69	Cu crust on diorite.
12611 R	211	5	11	11550	-56	Medium grained sausseritized diorite with pyrrhotite and chalcopyrite.
12612 R	100	-5	12	8864	-49	Diorite with sulfides.
12613 R	40	-5	8	3782	----	Abundant pyrite in tuffaceous chert beds overlying diorite.
12614 R	98	-5	-5	9235	148	Hornblende diorite with secondary diorite.
12948 R	46	-5	8	10610	165	Coarse grained diorite with moderate pyrite content.
12949 R	98	-5	20	3945	-75	Chert at contact with diorite.
12950 R	110	-5	6	10710	-54	Diorite overlying chert.
12951 R	210	-5	11	9399	-50	Metabasalt or fine grained diorite.
12952 R	152	-5	17	8604	-59	Diorite with minor chalcopyrite.
12953 R	1230	-5	11	4220	-40	Malachite in chert.
12954 R	223	-5	33	7477	-54	Fine grained diorite.
12955 R	279	-5	1515	9462	181	Hornblende diorite with minor pyrite and abundant magnetite.
12956 R	244	-5	18	10330	-66	Medium grained diorite with hornblende. Minor pyrite.

TABLE 2. Geochemical analyses of Hess Creek area soil samples (reported in ppm)

Sample Number	Copper	Lead	Arsenic	Titanium	Zinc
12587D 1/	32	7	12	5268	----
12862D	27	12	10	9699	155
12865D	30	9	11	4492	108
12868D	36	11	11	5955	122
12870D	28	8	16	8311	100
12872D	26	10	12	5317	102
12873D	30	6	13	6871	-75
12874D	42	6	13	5487	-117
12876D	31	5	16	10870	138
12877D	30	8	12	6350	163
12878D	29	6	11	6244	101
12879D	35.	10	11	6043	92
12880D	27	7	11	6030	152
12881D	29	9	10	6292	158
12883D	36	13	11	5621	-45
12884D	35	9	19	4334	-70
12886D	28	9	11	4893	120
12887D	43	16	10	4792	102
12888D	37	11	13	4214	89
12889D	34	11	9	5233	100
12890D	31	10	13	4299	-146
12892D	23	-5	18	5089	80
12893D	34	13	9	4604	88
12894D	32	5	14	4642	148
12895D	34	10	15	4299	171
12896D	40	5	18	4325	-34
12897D	41	10	16	4646	140
12898D	30	7	14	4164	-45
12903D	31	14	13	3945	98
12904D	39	9	20	4816	-47
12905D	44	10	14	4412	-115
12906D	32	8	11	4772	-40
12907D	46	-5	24	4329	179
12908D	41	-5	24	4613	-91

1/ Analyses by Los Alamos Scientific Laboratories, N. M.
As, Cu, Pb by x-ray fluorescence
Ti, Zn by neutron activation
(-) less than

Geochemical analyses of Hess Creek area soil samples - cont.

Sample Number	Copper	Lead	Arsenic	Titanium	Zinc
12909D	29	10	14	4507	74
12911D	40	-5	16	5114	-115
12971D	26	10	10	5117	93
12972D	29	-5	16	4876	-61
12973D	31	6	11	5133	-84
12974D	24	-5	14	5045	105
12975D	31	5	11	4677	-15
12976D	28	-5	18	9171	184
12977D	51	6	10	5571	88
12978D	26	11	11	6452	130
12979D	36	12	8	5915	-75
12981D	22	5	9	5990	-145
12982D	38	9	12	4706	125
12983D	33	7	13	4562	86
12985D	32	7	16	5103	-32
12986D	31	-5	14	5086	-51
12987D	45	7	15	4938	-39
12988D	70	12	10	4484	126
12989D	54	8	20	5158	112
12990D	108	54	11	3350	-107
12992D	62	9	12	4601	-24

TABLE 3. Geochemical analyses of stream sediment samples (reported in ppm)

Sample Number	Copper	Lead	Arsenic	Titanium	Zinc
10231S 1/	35	41	19	4872	-41
10232S	12	20	6	4982	-36
10233S	42	29	5	6420	129
10781S	29	9	12	4524	-47
10783S	34	6	16	3855	-161
10791S	48	-5	17	5546	114
10795S	27	-5	11	5080	86
10796S	50	5	16	6074	135
11179S	43	-5	7	4282	-105
11181S	37	-5	14	5276	-99
11182S	28	-5	13	4339	----
11183S	32	-5	12	4171	136
11184S	24	-5	9	4848	240
11185S	36	13	6	5333	115
11186S	33	7	9	4953	86
11187S	26	-5	14	5527	-49
11189S	46	7	8	8670	85
11192S	29	-5	16	4136	116
11193S	26	7	5	4203	-59
11194S	28	11	13	5753	111
12836S	65	-5	37	2626	168
12838S	32	12	7	5181	----

1/ Analyses by Los Alamos Scientific Laboratories, N. M.
As, Cu, Pb by x-ray fluorescence
Ti, Zn by neutron activation
(-) less than

TABLE 4. Geochemical analyses of pan concentrate samples (reported in ppm)

Sample Number	Copper	Lead	Arsenic	Titanium	Zinc
10780P 1/	100	30	-500	+10000	-200
10782P	150	50	-500	5000	-200
10793P	100	-10	-500	+10000	-200
10794P	200	20	-500	3000	200
11178P	200	10	-500	+10000	-200
11180P	150	10	-500	+10000	-200
11188P	200	10	-500	+10000	-200
12835P	300	20	-500	+10000	-200
12837P	150	10	-500	+10000	-200

1/ Analyses by Skyline Labs, Inc. Wheat Ridge, Colo.
All reported elements analyzed by optical emission spectroscopy
(+) more than
(-) less than

Rock Samples

Rock samples were generally chip samples taken from exposed outcrops of the diorite bodies. Due to the poor exposure throughout much of the study area, some samples were taken from barrow pits or rubble crop. If a sample was taken in this manner, or if it consisted of an individual high-graded rock, this was noted. In any case, each rock sample approximated 500-1000 grams (1-2 pounds) in weight.

Stream Sediment Samples

Stream sediment samples were collected with a steel shovel from the finer portion of the active channel or the most recently active part of a dry creek bed. Organic-rich material was avoided. Samples were put in water-resistant paper sample bags and air-dried before screening (minus 80 mesh) and analysis.

Soil Samples

Soil samples were collected from the "B" horizon at depths ranging from 15 cm. to 60 cm. (6 in. to 2 ft.). A gasoline engine-powered auger was used to penetrate into the permafrost layer near the surface.

Pan Concentrate Samples

Pan concentrate samples were collected to enhance recognition of resistant minerals with high specific gravity such as those containing tin, tungsten, radioactive elements, gold, zirconium, barium and some of the rare earths. Generally, these minerals are not easily detected using routine stream sediment sampling and analysis procedures.

As with the stream sediment samples, the pan samples were collected with a steel shovel from the silty, poorly sorted material in the active channel. A 35.5 cm. (14 in.) pan was filled, panned to approximately a 40 gram sample and carefully washed into a plastic bag.

GEOCHEMISTRY

Results of geochemical analyses of the soil samples taken in the Hess Creek area (fig. 4) do not show any anomalous copper values or indicate any trends.

A value of 1.56% copper was reported for an individual highgraded sample of copper-stained chert. Other individual rock samples yielded copper values of 0.12%, 0.18%, and 0.48%, as well as several in the 0.03% to 0.06% range. All but one of these is from the Hess Creek occurrence and are highgraded samples.

Possibly anomalous titanium values were also noted in many of the diorite samples. Of the approximately 65 diorite rock samples analyzed from the study area, 35 samples yielded values of from 1.0% to 2.9% titanium. The average of the other 30 diorite samples was 7300 ppm.

Several of the rock samples yielded anomalous arsenic values. Seven of these showed arsenic content greater than 60 ppm (106BR, 11099R, 11117R, 12589R, 12591R, 12955R). All of these samples, with the exception of 12591R (an iron-stained chert), are diorites. Two of the diorite samples (12605R and 12955R) were reported as having visible pyrite or copper staining in hand samples and showed values of 475 ppm and 1515 ppm arsenic, respectively.

RESULTS AND CONCLUSIONS

Based on the geological evidence, magnetometer data, and the results of the geochemical analyses, it is apparent that the exposed concentrations of copper are limited to local occurrences in small diorite dikes or sills within the Rampart Group. Therefore, due to the low concentrations and low tonnages implied by a dike or sill-like occurrence of disseminated copper in diorite, and the lack of significant copper mineralization, alteration, mineral zoning and alteration zoning typical of copper-porphyry deposits, the Rampart Group assemblage appears to have little potential for copper-porphyry deposits.

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