A GEOLOGICAL, GEOPHYSICAL AND PROSPECTING REPORT ON THE

TOMMY JACK PROPERTY

CONSISTING OF
TJ - 1 to 4, TJ 8 to 13 and TJ - 17, 18, 22
MINERAL CLAIMS
(56 UNITS)

OMINECA MINING DIVISION

Lat. 56 07 N **Long. 127 37 W**
N.T.S. 94 D / 4E

July and August 1999

Owner/Operator: Alan Raven

Author: Alan Raven

DECEMBER 1999

MADEIRA PARK, B.C.

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SUMMARY

The Tommy Jack property, owned 100% by Alan Raven, is comprised of 59 claim units. The property is situated 95 kilometres north of Hazelton, B.C. It lies in the Atna Range of the Skeena Mountains, near the confluence of Tommy Jack Creek with the Sicintine River.

The Tommy Jack property in conjunction with the adjoining Warren ground, 20 units on the northwest , covers a large zone of pervasive carbonate alteration. Within this zone are widespread gold-silver-lead-zinc-bearing quartz-carbonate veins in shears and stockworks in Bowser Group sedimentary rocks and in granodiorite (dacite) dykes and sills. The nature of the mineralization is compared to the Silver Standard Mine, 85 kilometres to the south (past production of 203,839 tonnes containing 463,000 grams of gold and 236,000,000 grams of silver) except that the gold grades are significantly higher at the Tommy Jack property

Work completed by Intertech Minerals in 1989, while involved in a joint venture with Noranda, included 14.1 kilometres of grid, geochemical sampling, geophysical surveys and geological mapping. The work generated a number of gold and multi-element targets to the southwest and southeast of the area worked by Noranda, some of which need more work to fully define, prior to drill testing. Several strong VLF anomalies were also found to correlate with the southwest geochemical anomaly. The targets generated by the Intertech work are now completely covered by the Tommy Jack property. The highest grade gold values found to date (2.2 oz/t gold) are from float found in the vicinity of the southeast anomaly. The work done by Raven in 1995 also extended the geochemical anomalies especially east of Unnamed Creek.

The results of the work conducted during the 1999 season were most encouraging. The understanding of the glacial transport of the high grade floats and the partial displacement of the soil anomalies has helped greatly in understanding the complexities of the anomalies.

The Self Potential survey delineated moderate to very strong anomalies which indicate graphite rich structures and possibly sulphide rich zones in the sediments. More work needs to be done to further access the genesis of the SP anomalies. The hand trench dug to bedrock (6800N 9110E Noranda grid) exposed a graphite rich zone that is strongly anomalous in gold and arsenic. This narrow shear zone is 10 metres east of a massive sulphide lens (vein) in sandstone which assayed .664 oz/t gold over 8 inches (Intertech). The large sulphide rich floats found down ice and east of the SP anomalies also contain graphite indicating that graphite rich structures could also be the conduits for the mineralizing solutions.

The hand trench at 18475N 21140E exposed structurally deformed, arsenic rich siltstone which is the most probable source of the arsenic soil anomaly in this area

The traverses on the southern portion of the property covered areas of unmineralized, structurally deformed sediments which included a dacite dyke that was equally deformed (shattered). This greatly helped in understanding the structural model for the property. Data and observations made on these traverses also explained the genesis of the mineralized quartz stockworks in the dacite dykes encountered in Noranda drill holes. These traverses if done in a meticulous matter will reveal in the creeks, dry stream beds and steep areas more outcrop and exposures than one would expect to find.

There is also the real potential of a sediment hosted (sandstone/siltstone) and/or intrusive hosted bulk mineable gold deposit. This potential is indicated by mineralized stockworks in sediments and intrusives encountered in Noranda drill holes immediately adjoining the Tommy Jack property to the northwest

The property is therefore considered to have excellent potential to host both high grade veins of the Silver Standard type and low grade stockworks or quartz vein zones in shears or granodiorite intrusions. (Allen 1989 Intertech report). This opinion is still valid today and includes the potential of a sandstone hosted bulk mineable gold deposit.

RECOMMENDATIONS

Self Potential Survey

The SP survey should be expanded in order to more fully understand the structural components of the property as indicated by the graphite rich structures and to locate precise targets for further trenching. A few lines should be run over the best Noranda drill results to determine if there is an SP signature, this would of course depend on permission from the owner of the "Warren" ground.

V.L.F Survey

An expansion of the area of covered by the previous VLF survey is warranted in order to delineate any extensions of the present anomalies and to locate any further anomalies.

Geochemistry

The expansion of a soil geochemistry survey to cover areas of interest is warranted including a more detailed infill survey in the main target zone and more detailed surveys in any new anomalies that are developed.

Geological Mapping

The work carried out this year has proven that meticulous work carried out in the drainages and steeper areas of the property will discover more bedrock exposures than originally was thought to be the case. Bedrock exposures can be located by very careful prospecting and then mapped by a geologist or other qualified personnel.

Trenching

Much more hand trenching can be carried out on the geophysical anomalies as they are located. This type of hand work is slow and labour intensive but is very beneficial to determining the genesis of some of the anomalies. The trenches will in some cases expose bedrock, the various soil layers and also help to determine the location of till cover on the property.

Prospecting

Detailed and meticulous prospecting will locate additional exposures of bedrock and floats of importance to the understanding of the property.

Previous data

The previous geochemical data generated by the soil surveys should be reassessed in view of the determination that the ice movement was from the north thus transporting the soil anomalies and floats uphill.

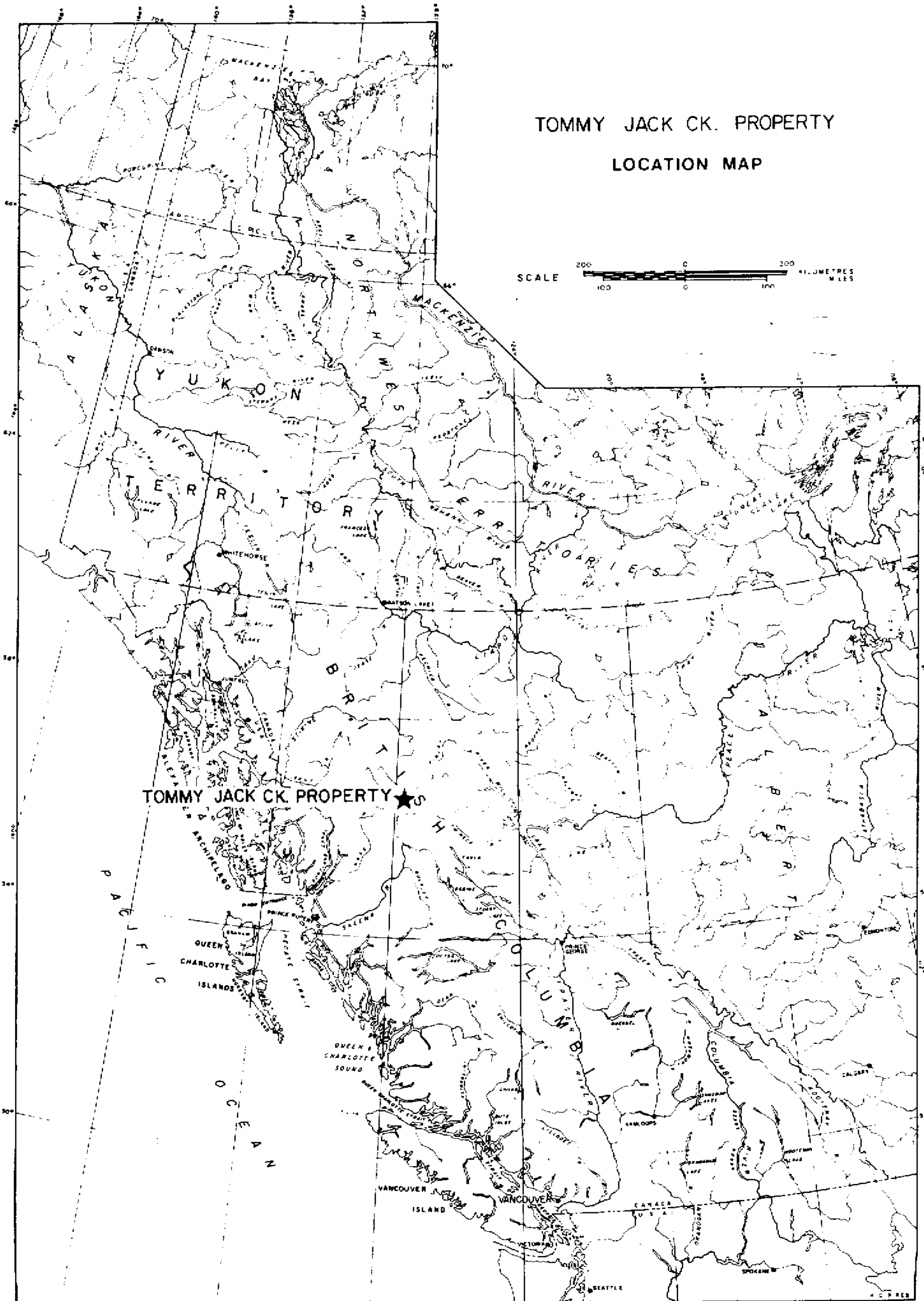
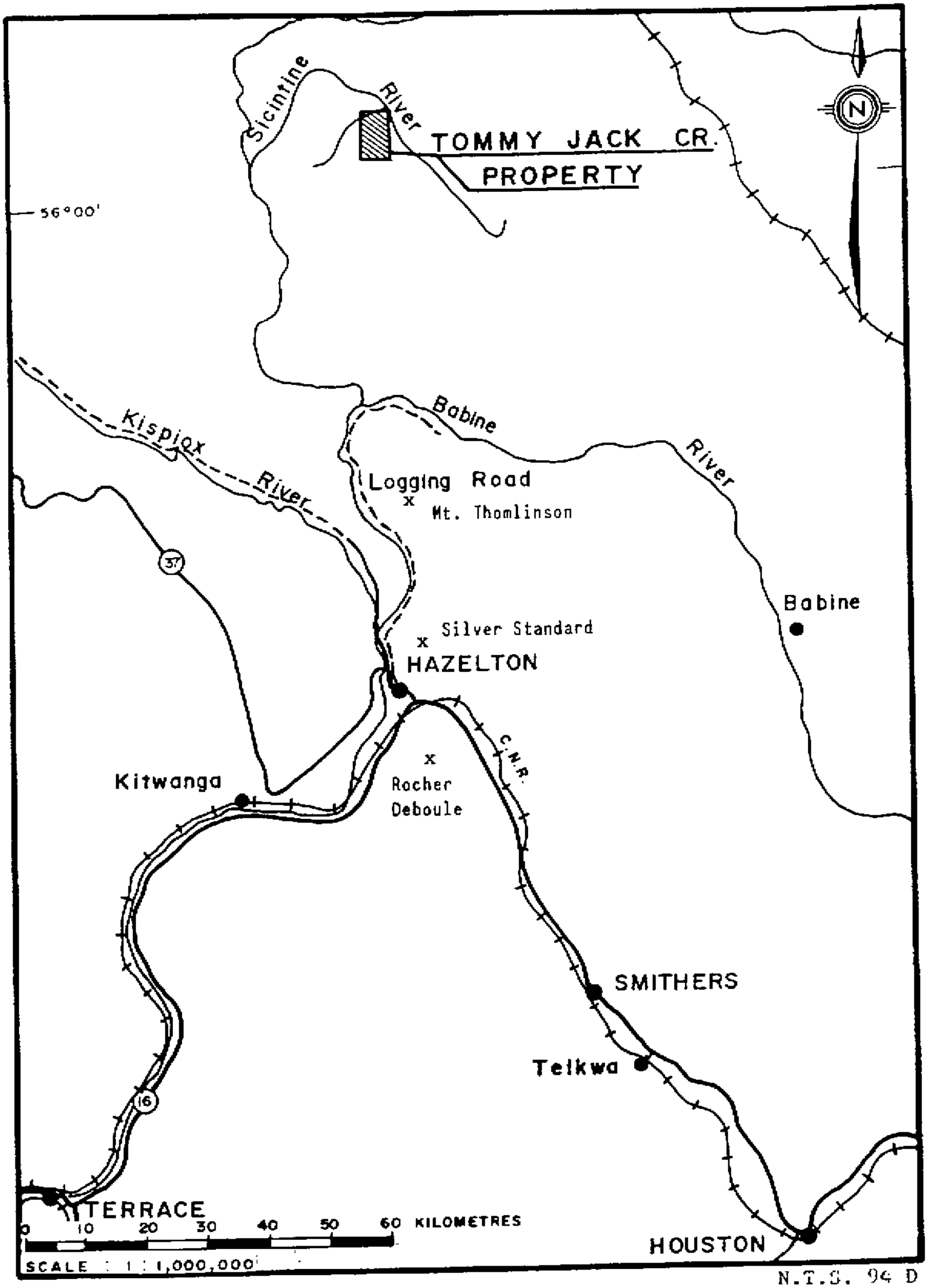

TOMMY JACK CK. PROPERTY
LOCATION MAP
SCALE
200
0
200
KILOMETRES
100
0
100
MILES
TOMMY JACK CK. PROPERTY
YUKON TERRITORY
NORTHWEST TERRITORIES
BRITISH COLUMBIA
ALBERTA
ALASKA
PACIFIC OCEAN
MACKENZIE
WHITEHORSE
WATSON LAKE
PRINCE RUPERT
PRINCE GEORGE
QUEEN CHARLOTTE ISLANDS
QUEEN CHARLOTTE SOUND
VANCOUVER ISLAND
VANCOUVER
VICTORIA
KAMLOOPS
EDMONTON
CALGARY
SPOKANE
SEATTLE
CANADA
U.S.A.

FIGURE — I



N.T.S. 94 D

INTERTECH MINERALS CORP.

ACCESS MAP

TOMMY JACK CREEK PROPERTY

Liard Mining Division - British Columbia

x Mineral deposits mentioned in text.

Figure 2

OBJECTIVES OF THE PROGRAM

The objectives of the 1999 program were multiple: to test and evaluate the usefulness of a self potential survey in this geological environment, to ascertain the genesis of the soil anomalies, to locate and map as many bedrock exposures as possible in the target areas, to locate suitable targets for hand trenching, to trace the high grade floats to their source, and to examine the southeast area for any indications of surface mineralization

INTRODUCTION

The Tommy Jack property covers widespread gold-multi-element soil anomalies, VLF and self potential anomalies occurring in Bowser Group sedimentary rocks intruded by dacitic dykes. This ground is part of a claim package held under option by Noranda in a joint venture with Gold Cap and then Intertech Minerals (1986 to 1989). The "Warren" ground that adjoins the Tommy Jack property on the northwest was where most of the drilling has taken place but a much larger area (139 units) was the subject of preliminary exploration programs. These programs consisted of geochemical, geophysical geological surveys which delineated a much larger area than that covered by the "Warren" ground. The anomalies, soil and geophysical, have not been fully defined and need much more work to fully delineate.

The purpose of this report is to summarize the results of the fieldwork conducted in 1999 by Alan Raven. The 1999 season's work consisted of establishing 3.1 kilometres of new grid, re-establishing 3.8 kilometres of Intertech grid, geophysical survey (self potential) of 4.3 kilometres (fig. 5), geological mapping of approximately 18 hectares at a scale of 1:2,500 (fig. 6) and traverses covering approximately 500 hectares at a scale of 1:10,000 (fig. 3). Also mentioned in this report is some of the previous work carried out by Noranda, Intertech and Raven.

LOCATION, ACCESS, PHYSIOGRAPHY

The Tommy Jack property is situated 95 kilometres north of Hazelton. It lies immediately to the south of the confluence of Tommy Jack Creek with the Sicintine River, which in turn flows into the Skeena River.

Access is by helicopter, about an hours flight from Smithers. There are presently new logging roads being built into the immediate area and the closest road is about 10 kilometres to the south.

The property is in the Atna Range of the Skeena Mountains. The slopes are gentle to moderately steep with elevations ranging from 1140 to 1760 metres. A heavy virgin forest growth of balsam fir, spruce and hemlock covers most of the claim area up to 1500 metres elevation, above which heather, scrub fir , grass-covered areas and talus predominate.

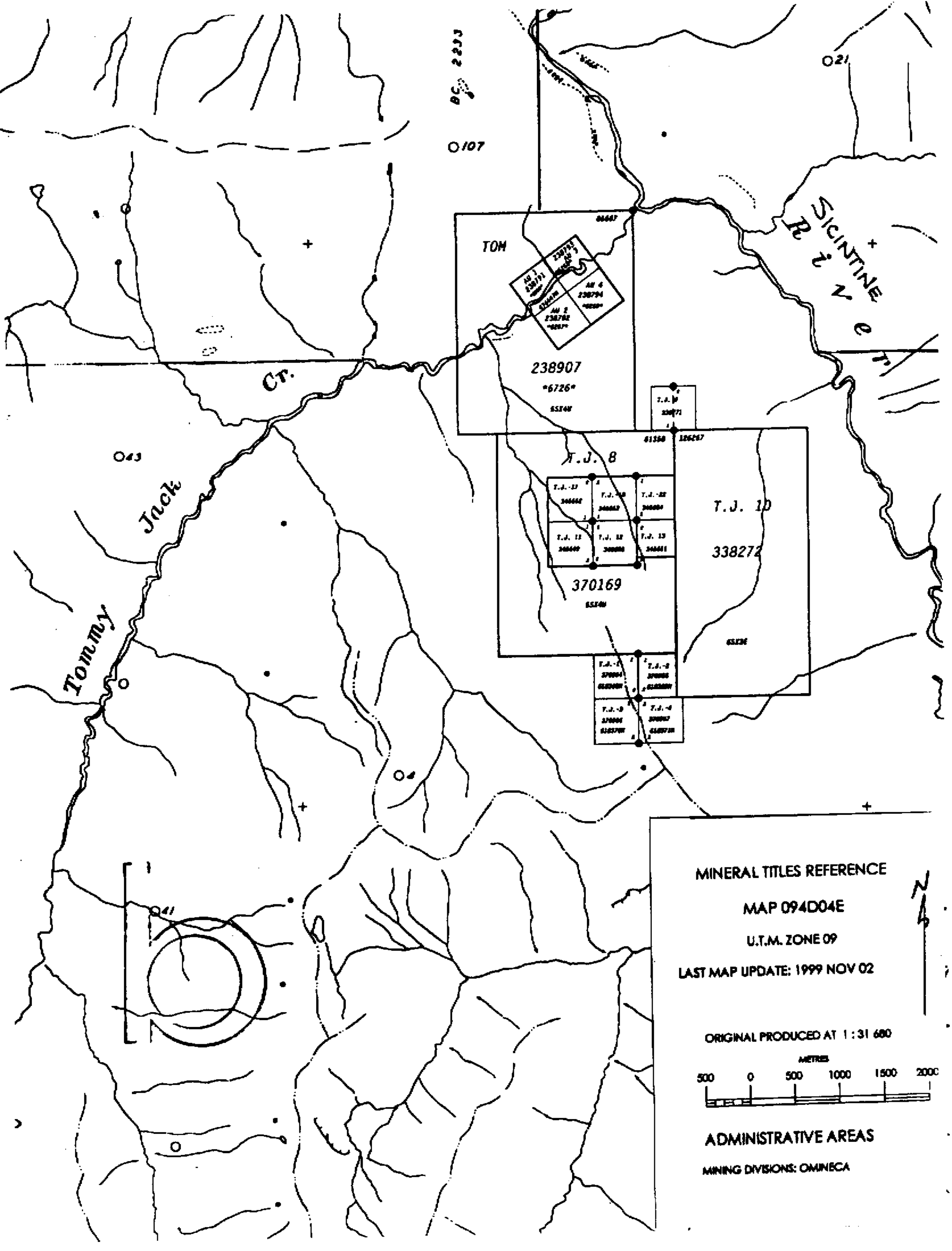
CLAIM DATA

The Tommy Jack property comprises 59 claim units (6 units are over staked by a 20 unit claim)

All claims are owned 100% by Alan Raven

CLAIM NAME	TENURE NUMBER	WORK RECORDED TO	STATUS Good standing	TAG NUMBER	UNITS
TJ - 1	370954	2000/07/31	2000/07/31	618368M	1
TJ - 2	370955	2000/07/31	2000/07/31	618369M	1
TJ - 3	370956	2000/07/31	2000/07/31	618370M	1
TJ - 4	370957	2000/07/31	2000/07/31	618371M	1
TJ 8	370169	2000/07/11	2000/07/11	61358	20
TJ 9	338271	2000/07/28	2000/07/28	625415M	1
TJ 10	338272	2000/07/20	2000/07/20	126267	18
TJ 11	345649	2000/05/02	2000/05/02	625519M	1
TJ 12	345650	2000/05/02	2000/05/02	625520M	1
TJ 13	345651	2000/05/02	2000/05/02	625521M	1
TJ - 17	345652	2000/05/02	2000/05/02	625416M	1
TJ - 18	345653	2000/05/02	2000/05/02	625417M	1
TJ - 22	345654	2000/05/02	2000/05/02	625422M	1

Note: TJ - 11, 12, 13, 17, 18 and 22 will be included within TJ - 8 when this work is filed.



MINERAL TITLES REFERENCE
MAP 094D04E
U.T.M. ZONE 09
LAST MAP UPDATE: 1999 NOV 02
ORIGINAL PRODUCED AT 1 : 31 680
METRES
500 0 500 1000 1500 2000
ADMINISTRATIVE AREAS
MINING DIVISIONS: OMINECA
Sicintine River
Tommy Jack Cr.
TOM
238907
"6726"
T.J. 8
370169
T.J. 10
338272

HISTORY OF THE PROPERTY

- Canex Aerial Exploration 1964-65
- Lorne Warren 1984
- Optioned by Noranda 1984-85 - geological and geochemical surveys
- Option continued and additional ground staked Noranda/Gold Cap JV 1986-87 - geological, geochemical, geophysical surveys with drilling carried out on the "Warren" ground
- Option continued Noranda/Gold Cap/Intertech JV (new targets generated) 1988-89 - geological, goechemical and geophysical surveys on the "Raven" ground.
- Property idle but in good standing. Option with Warren dropped
- Raven acquired 19 units as some of the ground covered by the new targets lapses 1995 - geological, geochemical and prospecting
- Raven acquired 6 units as additional ground lapses (Warren also acquires adjoining claims) 1996
- Raven acquired 24 units (which include 6 units staked in 1995) in 1999 to cover target areas -

  - geological, geochemical, geophysical surveys and prospecting.
- Approximate total expenditures on exploration in the immediate area to date is $650,000.00

Note: The majority of the Noranda/Gold Cap monies were spent on Warren's ground which adjoins the Tommy Jack property on the northwest with the majority of the remainder spent on what is now the "Raven" ground. (TJ series of mineral claims)

GEOLOGY

REGIONAL GEOLOGY

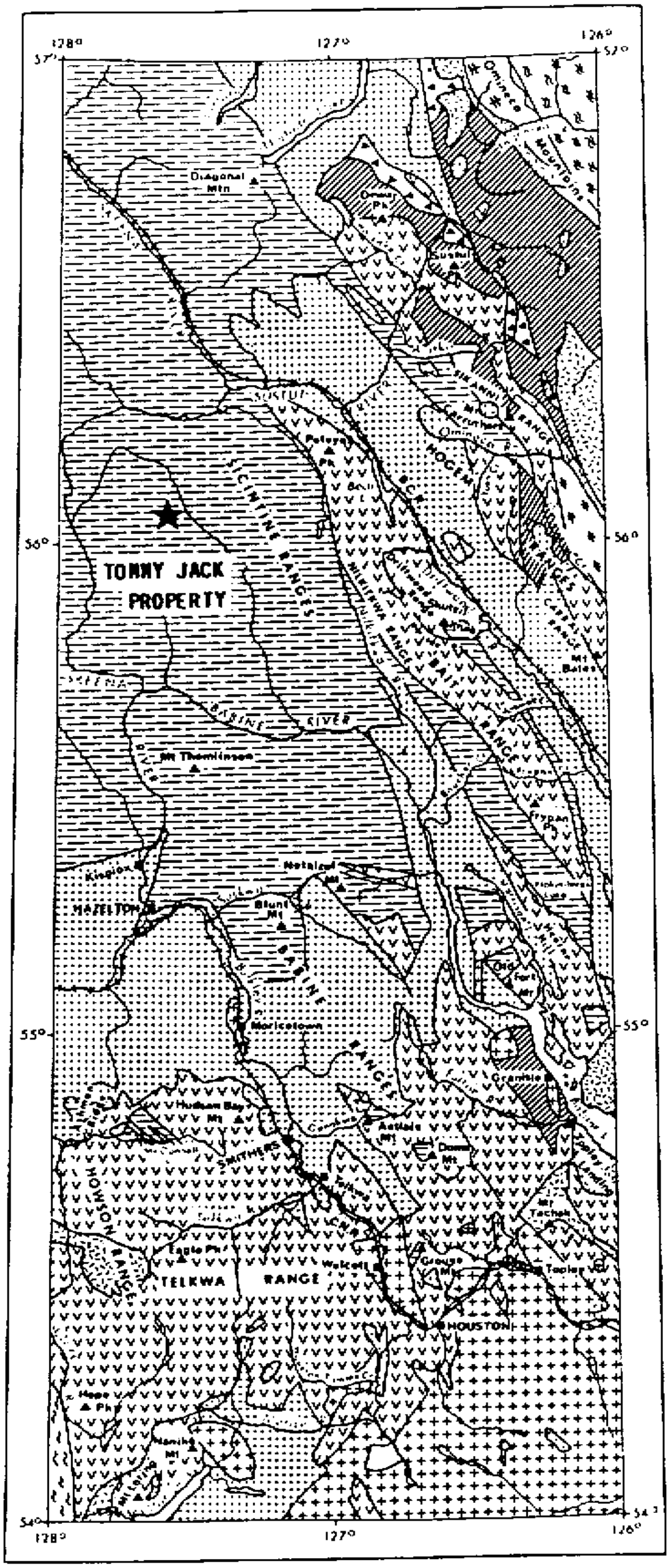
The Tommy Jack Creek property is in the Intermontane belt, one of the five major subdivisions of the Canadian Cordillera. The belt consists of Mesozoic volcanic and sedimentary rocks and is bounded on the east by the metamorphic rocks of the Omineca Belt and on the west by the Coast Crystalline Belt.

The rocks underlying the claim area are part of a thick assemblage of marine and non-marine sediments composed of shale, siltstone, sandstone and conglomerate (fig 2). The assemblage, referred to as the Bowser Lake Group, was deposited in a broad basin (Bowser Basin) at least 200 kilometres wide and 300 kilometres long. This basin is interpreted by Eisbacher (1977) to be a marginal basin (developed along the continental margin), open to the west and filled with sediments derived from a tectonically thickened welt in the east and from the older terranes and volcanic chains on the west. Subsequent sea floor spreading and subduction resulted in 1) the welding of the older volcanic-plutonic terranes onto the continental crust and 2) uplift and deformation of the rocks of the Bowser Basin.

Intrusive into the Jurassic Bowser Group sedimentary rocks are a Cretaceous series of stocks and small batholiths of porphyritic granodiorite and quartz monzonite termed the Bulkley Intrusions. They lie in a belt 80 kilometres wide and 300 kilometres long, and include a cluster of intrusions in the Atna and Sicintine Ranges in the north and extend southward to include the Quanchus Intrusions in the Whitesail Lake area. The Tommy Jack Creek property is ten kilometres north of the known northern limit of this belt.

The Bulkley Intrusions have a number of common characteristics including:

1) Cretaceous age (70 to 84 million years)
2) high level characteristics
3) host to a number of important copper-molybdenum and molybdenum-tungsten deposits (Carter, 1981) such as Mt. Tomlinson and Glacier Gulch, and
4) host to a number of important precious and base metal deposits such as the Silver Standard and Rocher Deboule Mines, both near Hazelton



GENERAL GEOLOGY

of the

SMITHERS, HAZELTON

and

McCONNELL CREEK MAP-AREAS

LEGEND

Tertiary (Paleocene to Miocene)

- Ootsa Lake and Endako Groups

Lower Cretaceous (Hauterivian) to Eocene

- Skeena and Sustut Groups

Middle to Upper Jurassic (Bathonian to Oxfordian)

- Bowser Lake Group

Lower to Middle Jurassic (Sinemurian to Callovian)

- Hazelton Group

Upper Triassic to Lower Jurassic

- Intrusive Rocks

Upper Triassic

- Takla Group

Upper Paleozoic

- Asitka Group
- Cache Creek Group
- Lay Range Assemblage

Crystalline Terranes

- Omineca Crystalline Belt
- Coast Plutonic Complex

Kilometres

0 60 120

G.S.C.

After Tipper and Richards (1974)

REGIONAL GEOLOGY

Figure 4

PROPERTY GEOLOGY

The Tommy Jack property is on the eastern edge of the Bowser Basin where tectonic movement has uplifted the sediments in collision with the continental margin and created pathways for the intrusive rocks (Late Cretaceous Bulkley Suite and to the east the Eocene Kastberg Suite).

The property is underlain by the Bowser Sediments which in the claim area consist of interbedded sedimentary clastics; siltstone, arkosic sandstone, shale and argillite with minor conglomerates. There are exposures of the siltstone and sandstone throughout the property but only minor conglomerate was encountered in some of the drill holes. These beds are gently folded with a generally westward dip on the west of the East Scarp of Moret Ridge, are deformed by a series of fault zones within the property and dip gently east on the eastern boundary of the property.

Faulting has been the result of tectonic extension which has caused a series of down dropped blocks on the property. Each successive block has dropped as one moves from west to east across the property. The majority of faults and airphoto lineaments strike 340 to 360 degrees but there are also east - west structures indicated on the airphotos. Faulting is observed on the ground, in drill holes and on air photographs. There is a possible uplift of one of the central blocks as indicated by a circular feature expressed on the airphoto. This may be an expression of a buried intrusive from which the dacite dykes originated and/or from which the mineralizing fluids were derived.

The sediment package is intruded by a felsic unit of the Cretaceous Bulkley Intrusive Suite(?), field named dacite. Multiple intersections of the dacite in the drill holes suggests that there are multiple dykes within each of these fault zones (dyke swarms) or that intense faulting has broken single dykes into small sections. The dacites have pervasive sericite and carbonate alteration with the mafic minerals altering to chlorite.

The quartz and quartz/carbonate veining is multi-directional in both the sediments (sandstone and siltstone) and the dacite dykes. The data supports the interpretation that this veining occurs within broad fault zones within all rock types that the structures penetrate e.g. stockworks in both sandstone/siltstone and the dacite dykes were noted in drill holes.

ROCK SAMPLES

A total of 35 rock samples were collected from various locations on the Tommy Jack property in the 1999 season (figs. #3 and 6). These samples were collected from bedrock outcrop or exposures except for TJR-5 to 9 which are floats, TJR-11 and 28 which are sub-crop.

TJR-2, 3 and 4 were collected from the hand trench #1 in fig. 3, dug to expose the SP anomaly at 6800N 9110E (anomaly #5). These samples carried anomalous gold values and were also highly anomalous in arsenic. The samples were taken from the graphitic shear/fault zone outlined by the SP survey. The graphite zone is within the siltstone, in contact to the west with sandstone. The samples are located approximately 10 metres east of the high grade (.664 oz/t) sample of massive pyrite in the sandstone. (sampled during Intertech program)

TJR-5 is a sharply angular piece of sandstone float that was located a short distance down ice from the area of the SP, soil and the VLF anomalies of the main area surveyed in 1999. This sandstone is fractured, pyritic with pyrite fracture fillings, carbonate altered, weakly anomalous in gold, strongly anomalous in arsenic and sulphur and weakly anomalous in lead and zinc.

TJR-19, one of the samples from the hand trench #2 (TJR-17 to 21), is weakly anomalous in gold and moderately anomalous in arsenic. The series of adjoining samples (TJR- 17 to 21), are all anomalous in arsenic, are from altered siltstone, are located in an arsenic soil anomaly and are located in a weak SP anomaly area.

TJR-27 is sandstone exposed in the bed of Unnamed Creek approximately 5 - 10 metres upstream of the dacite dike mapped by Allen (fig # 3). This sandstone is mineralized with galena and pyrite. It is strongly anomalous in silver, lead and cadmium as well as anomalous in zinc and sulphur.

In the area of trench #2 the arsenic values in the siltstone are sufficient to generate the arsenic soil anomalies.

NOTE: No samples of quartz with significant sulphide content collected in the 1999 season were analyzed because all samples of sulphide rich quartz collected by Noranda and Intertech returned good to excellent gold values (.2 to >2.0 oz/t)

ROCK SAMPLES TOMMY JACK 1999

SAMPLE #	DESCRIPTION	Au	Ag	Pb	Zn	As
TJR-1	o/c, sdst with qtz stwk, grab across 0.5 m.	<5	<0.2	<2	24	<2
TJR-2	o/c, black/brown slst with minor qtz veins, iron stained, fractured, manganese oxide, rep X 0.25 m.	85	0.4	20	30	240
TJR-3	o/c, continuous to #2 going west, qtz zone in slst with pyrite and graphite, rep X 0.22m.	195	0.2	10	10	162
TJR-4	o/c, continuous to # 3 going west, slst with minor pyrite, iron stained, rep X 0.30m.	100	0.2	10	28	248
TJR-5	float, angular sdst with disseminated pyrite and pyrite fracture fillings, possible arsenopyrite	15	0.6	32	108	394
TJR-6	large angular floats sub-crop?, black slst with qtz-carbonate veining and pyrite	<5	0.2	<2	34	38
TJR-7	float, sub-crop?, hornfelsed sdst with qtz veining and pyrite	<5	0.2	<2	116	32
TJR-8	angular float, micaeous altered sdst or altered dacite, qtz veining with pyrite	<5	<0.2	2	46	8
TJR-9	float, angular sdst with qtz stwk	<5	<0.2	<2	12	6
TJR-10	o/c, grab, foliated altered sdst, arsenopyrite?	<5	0.2	2	82	20
TJR-11	float, sub-crop, fine sdst with qtz-carb veining, contains minor remaining pyrite	<5	<0.2	2	48	32
TJR-12	o/c, qtz-carb zone, chip X 0.5 m	<5	<0.2	<2	22	16
TJR-13	o/c, qtz vein in qtz-carb zone, rep X 0.25m	<5	<0.2	<2	<2	<2
TJR-14	o/c, qtz-carb zone, breccia, rep X 0.25m	<5	0.2	4	32	<2
TJR-15	o/c, sdst with fine qtz filled fractures	<5	0.2	4	90	<2
TJR-16	o/c as #15	<5	0.2	4	78	6
TJR-17	o/c, altered slst with qtz-carb veining, chip X 0.7m	<5	1.4	<2	2	66
TJR-18	o/c, altered slst with qtz-carb veining, chip X 1.0m	<5	0.2	2	16	98
TJR-19	o/c, altered slst with qtz-carb veining, chip X 1.0m	25	0.6	2	34	132
TJR-20	o/c, altered slst with qtz-carb veining, chip X 1.0m	<5	<0.2	2	26	88
TJR-21	o/c, altered slst with qtz-carb veining, chip X 0.8m	<5	0.2	2	30	66
TJR-22	o/c, qtz-carb from trench (TJR 17 to 21)	<5	<0.2	2	34	12
TJR-23	o/c, altered slst with qtz-carb veining, chip X 0.75m.	<5	0.2	6	52	34
TJR-24	o/c, slst, chip X 0.4m	<5	0.2	<2	108	16
TJR-25	o/c, slst, chip X 0.6m continuous below #24	<5	0.2	2	120	16
TJR-26	o/c, slst, grab	<5	0.2	2	114	8
TJR-27	o/c, sdst with qtz stwk, galena	<5	2.6	288	282	30
TJR-28	sub-crop, sdst with qtz veinlets, grab	<5	0.2	2	90	62
TJR-29	o/c, black slst, grab	<5	0.4	2	80	40
TJR-30	o/c, black slst, grab	<5	<0.2	4	116	8
TJR-31	o/c, sdst with qtz-carb veining, chip X 0.3m	<5	0.4	12	70	70
TJR-32	o/c, sdst with qtz-carb veining, chip X 0.5m	<5	0.4	4	40	24
TJR-33	o/c, qtz vein chip X 0.35m.(#31, 32, 33 continuous)	<5	<0.2	<2	20	64
TJR-34	o/c, altered micaeous sdst (felsic dike ?) pyrite, qtz veins, carb. alteration, grab	<5	<0.2	<2	42	2
TJR-35	o/c, altered micaeous sdst (felsic dike ?) pyrite, qtz veins, carb. alteration, grab	<5	<0.2	2	68	<2

o/c = outcrop (exposure), sdst = sandstone, slst = siltstone (includes mudstone, claystone and very fine sdst), qtz = quartz, stwk = stockwork, carb. = carbonate usually ankerite, rep. = representative, X = across
Analytical values: Au in ppb, Ag, Pb, Zn and As are in ppm.

Highly anomalous rock grab samples, 1987-1989

Tommy Jack Creek Property

Sample No.	Location	Size cm	Description	Sulfides	Material Sampled	Au oz/ton	Au ppb	Ag oz/ton	Ag ppm
19700	above treeline		qz,py,as,gn	60.0	talus	0.206		32.07	
26778	above treeline		qz,as,py	0.5	talus	0.204		0.18	
76110	7200 N, 9313 E	10	qz,Fe,gn	1.0	float		13,730		47
76111	7200 N, 9313 E	15	qz,Fe,py	2.0	float		6,780		30
76121	Unnamed Creek	13	qz (banded), py	2.0	float		5,400		2,086
76122	Unnamed Creek	4	qz,ank,py,sp,gn	13.0	cobble		14,950		208
76124	Unnamed Creek	15	qz,ank,py,gn,sp	33.0	cobble		29,900		227
78072	above treeline	5	qz,py,gn?		float	0.730		4.63	
86615	near TJ87-5		qz,CO3,py,as,gn		trench		12,210		40
86619	Unnamed Creek	4	py,qz,sp,gn	85.0	float	0.755		2.33	
86621	Unnamed Creek	6	py,qz,gn	90.0	float	0.922		3.33	
88881	Unnamed Creek	5	qz		outcrop	0.201		2.31	
88886	Unnamed Creek		qz,py,gn		float	0.413		1.97	
88892	Unnamed Creek		qz,py,as,gn,sp		float	0.522		3.00	
88893	Unnamed Creek		qz,py,gn		float	1.160		24.84	
88895	S of grid	boulder	qz,py,as?		float	0.249		0.83	
88897	above treeline		qz,py		talus	0.552		2.19	
88979	above treeline		?,as,gn,py		talus	0.218		0.66	
92601	Beaver Creek	boulders	qz,gn,py	50.0	float	1.080		7.96	
99081	above treeline		qz,py,as,gn,sp	50.0	float	0.221		0.83	
99085	above treeline		qz,py,as,td,gn	65.0	talus	0.164		41.55	
99091	Beaver Creek	boulder	qz,sp,td,gn,py	60.0	float	0.414		74.10	
99097	Beaver Creek	boulder	qz,py,gn	95.0	float	0.966		6.54	
TJ 5A	Unnamed Creek	boulder	qz		float	0.241			195
TJ 6	6820 N, 9090 E		qz		trench	0.664			19
TJ 8	Beaver Ck. tr.		qz		float	0.445			69
TJ10	Moret ridge		qz		float	1.01			41
906318	Unnamed Creek	7	qz,py,gn,sph		float	2.17		17.97	
906319	6670 N, 1000 E	13	qz,py,as		float	0.042		0.29	
906322	Beaver Ck. tr.	8	qz,py		float	0.049		0.48	
906323A	Beaver Ck. tr.	15	qz,py,gn,sp,cpy		float	0.999		55.85	

Significant DDH intersections, 1986-1987
Tommy Jack Creek Property

Hole	Interval, m	Width, m	gmt Au	gmt Ag	Rank*
TJ86- 1	61.6-62.75	1.15	2.57	12.7	
	78.0-79.0	1.0	3.63	23.0	
TJ86- 2	42.2-45.5	3.3	2.01	35.3	9
	46.7-47.15	.45	9.60	121.0	
	54.6-55.6	1.0	2.09	2.7	
TJ86- 4	24.1-24.9	0.8	8.90	151.0	8
	67.2-68.1	0.9	4.12	7.6	
TJ86- 5	9.8-11.8	2.0	1.95	29.6	
	21.6-28.2	6.6	4.30	83.6	1
TJ87- 1	12.9-13.9	1.0	1.89	164.0	
	16.8-21.6	4.8	1.57	23.6	7
TJ87- 8	50.1-51.0	0.9	5.04	37.0	
TJ87-10	8.1-11.6	3.5	1.00	27.0	
TJ87-11	4.0- 6.5	2.5	2.54	158.0	10
TJ87-14	28.7-29.3	0.6	31.85	129.0	2
	38.2-39.6	1.4	1.99	5.0	
	59.1-60.6	1.5	3.27	10.3	
TJ87-15	42.1-42.7	0.6	6.24	17.5	
	49.8 50.3	0.5	7.68	27.1	
	56.5-56.9	0.4	12.9	12.0	
	69.4-70.0	0.6	4.25	17.6	
TJ87-16	14.6-15.0	0.4	0.38	1380.0	
TJ87-18	27.3-28.0	0.7	3.63	16.1	
TJ87-19	16.4-16.9	0.5	6.48	289.0	
TJ87-20	8.5-10.2	1.7	4.69	71.3	6
	16.4-16.7	0.3	7.75	42.5	
TJ87-22	17.2-17.4	0.2	13.0	46.2	
	52.9-54.0	1.1	1.98	8.9	
TJ87-23	11.3-12.6	1.3	14.6	36.3	3
	13.7-13.9	0.2	48.5	1243.0	5
	22.3-23.3	1.0	3.77	80.9	
TJ87-25	4.2- 4.3	0.1	40.6	274.0	
	8.5- 8.9	0.4	26.1	91.8	4

*Rank by gold content (= width x grade)

SELF POTENTIAL SURVEY

OBJECTIVES

The objectives are to determine if S.P. will delineate structure, rock type and/or sulphide mineralization in this geological environment while at the same time testing the feasibility and usefulness of this type of geophysical survey on the Tommy Jack property.

BASICS OF THE SELF POTENTIAL GEOPHYSICAL SURVEY

The self-potential method is small-scaled, versatile, and provides a simple, reliable and economical means of near-surface electrical prospecting for certain base metal sulphides and other mineral resources. (E.G. Pye, Director, Ontario Geological Survey)

Important Facts (Burr, S. V. 1982)

1. Natural SP anomalies of a few hundred to over a thousand millivolts, and of negative sign by convention, are caused by the iron sulphides pyrite and pyrrhotite, the copper sulphide chalcopyrite, and the native element graphite. Graphite gives the strongest SP reaction, followed by pyrrhotite, pyrite, and chalcopyrite. Strong negative anomalies are also reported over chalcocite, covellite and anthracite (Sato and Mooney 1960).
2. Manganese oxides (psilomelane and pyrolusite wads) have been observed to give positive SP anomalies.
3. The peak of an SP anomaly is detected with the measuring pot positioned directly above the source.
4. The SP method does not determine secondary fields, so survey results are much easier to interpret. It does not respond to subsurface valleys, wet clay, shears, or faults; and, in the author's experience, the SP method does not provide results which could lead to a false anomaly.
5. The SP method responds to good conducting sulphides (both oxidized and unoxidized bodies), graphite, and nonconducting (disseminated) sulphides if these sulphides are oxidizing.
6. The SP method does not respond to zinc, lead, gold, or silver minerals. However, some iron or copper sulphides are generally present with these metals and, if oxidizing, will result in an anomaly.
7. In the case of a strong and obvious graphite SP anomaly, the method cannot indicate the presence or absence of associated sulphides.

Brief Theory (Burr, S.V.)

Most explanations of the SP phenomenon propose that a "wet" sulphide (or graphite) body develops negative and positive electrical potentials at its top and bottom, resulting in a both metallically and electrolytically mediated "flow" of electrochemically generated current around and through the body.

It is possible that sulphide and graphite bodies in contact with ground water electrolytes induce a "spontaneous" DC flow of current, but local ground currents are not solely related to potential differences arising from spontaneous polarization of a conducting body. The author considers that the natural telluric fields and currents encircling the earth provide a natural applied electrical field which - close to an electrolyte-bathed SP body - can give rise to a "conducive" spontaneous polarization effect which distorts the local primary geosymmetry of natural electrical fields near the earth's surface.

Self Potential Equipment

The equipment used on the project was a digital Fluke multimeter (Model 77) with the scale set to accurately read to +/- 1mV, a 300 metre spool of IP wire on an IP spool, two porous SP pots filled with a supersaturated solution of copper sulphate and a canvas bag partially filled with wet clay/humus material for each pot.

ORIENTATION and TEST SURVEY

The orientation and test survey was carried out in the area east of Noranda grid co-ordinates 6800N 9000E which is equal to Intertech grid co-ordinates 19150N 21300E. The rock exposed in the Intertech trench is sandstone with a small massive sulphide (pyrite) vein (lens?) which assayed .664 oz/t over 8 inches. This region also has a gold soil geochem anomaly with values of 30 to 6200 ppb in a 30 X 40 metre area. The test was carried out over known sulphide mineralization with good gold grades within the sandstone. The graphite rich zone was not known at the time of the orientation survey. This area was chosen because it has multi-element soil and VLF anomalies, high grade floats in the area, a confirmed gold showing and is located on a major lineament.

Note: Only "bare" SP pots were used in the test/orientation survey otherwise all the survey was carried out using the same methodology as described below.

METHODOLOGY

The baseline location was chosen to be between four known VLF anomalies, within the area of multi-element soil anomalies and within the physical parameters of the available equipment.

The previously established grid stations were used throughout the SP surveys (whenever possible) so that previous data, geophysical and geochemical, would correlate to exactly to the same reference points as the new data generated in 1999.

The methods used on this survey were the ones described by S.V. Burr (appendix 3). The survey was carried out using a 300 metres of wire wound on an I.P. reel, two porous pots each in a canvas bag and a Fluke multimeter (Model 77 with the scale set so the readings were accurate to 1mV). In the primary target area (see figure #5) an S.P. baseline was set up with stations and readings taken every 25 metres plus wherever the baseline crossed one of the east - west gridlines. The main area baseline is slope corrected, with a bearing of 170 degrees, a total length of 800 metres and the stations marked with Tyvek tags secured with wire ties. A base station was set up wherever a grid line crossed the SP baseline and the moving pot was used to take readings on both sides of the baseline. The grid line readings were taken at 10 metre intervals for 250 to 300 metres on both the east and west side of the baseline. The detail readings were taken in the areas requiring more definition (2m down to 15 cm spacing depending on the detail required). The grid on the east side of Unnamed Creek was much smaller with a smaller baseline and survey area but used the same spacing for stations and readings as the main grid area. A total of approximately 900 readings were taken on these surveys (10 to 2 metre spaced readings, calculations and normalized values are tabulated in appendix #2)

RESULTS

The SP survey was successful in proving it is a feasible, useful and cost effective exploration tool to use on the Tommy Jack property. The survey indicated the placement of structures related to the graphite enriched fault/shear zones. The anomalies correlated very well with the previous VLF anomalies generated by the Intertech survey (Allen 1989) and accurately located the probable source of the VLF conductors. This accuracy enabled me to dig several hand trenches and pits to test these anomalies. Several of the anomalies are too deep to practically trench by hand particularly on the western side of the main area (fig. 5). It appears, at this early stage, that the SP survey will also help to delineate the rock units by their SP signature. The strongest anomaly is coincident with a VLF anomaly and has been generated mainly(?) by the graphite content of the structure.

The SP anomalies in the main target area are;

#1 - 18500N (south) 21560E to 19225N 21380E a > 750 metres

#2 - 18300N 21610E to 19225N 21305E > 900 metres

#3 - 18800N 21240E to 18900N 21220E > 100 metres

#4 - 18700N 21200E to 18900N 21140E > 200 metres

#5 - northern part of #1

#6 - northern part of #2

#7 - 18600N 21400E +/- 100 metres

#8 - 18300N 21210E +/- 100 metres (weak anomaly)

Description of the anomalies

#1 - This includes #5 which forms the northern part of the anomaly. The normalized values at the grid lines are, from the south, -337, -360, -476, -536, -474, -720, -587 and -522 mV. I interpreted these values to be in the area of the graphite except for the most southern (-396) reading which may align more with the #2 anomaly than with the #1 anomaly. This anomaly contains the sulphide zone that was exposed in the Intertech trench and the graphite zone discovered in 1999. The graphite is located within 10 metres of the massive sulphide vein and probably masked the sulphide signature.

#2 - This includes #6 which forms the northern end of the anomaly. The normalized values, from the south, are -396, -508, -456, -439, -415, -303, -349, -376 and -439 mV. I interpret that the values in this anomaly may have been generated by sulphide veins/zones because of the more gradual change in values in comparison to the graphite zone and the overall lower values. This gradual change may also be due to a much greater depth to bedrock but I did not see anything that would in indicate a significant change in the depth of the overburden.

#3 - The normalized values, from the south, are -376 and -429 mV. This is a short but strong anomaly which may be generated by sulphides and not graphite as per my interpretation in #2.

#4 - The normalized values, from the south, are -213, -412 and -416 mV. This is also a short but strong anomaly with values in the same range as #2 and #3. I also believe that this anomaly may be caused by sulphides and not graphite. There is a dramatic change in values between stations 21120E and 21110E on line 18900N where the values change 242 mV within 10 metres thereby indicating a rock type change.

#8 - This weak anomaly is only about 100 metres and appears to be isolated from the others. It is however in an arsenic soil anomaly and therefore may have more significance than the numbers suggest.

TRENCHING

Hand trenches and pits

Trench #1 - dug to expose the SP anomaly

Co-ordinates: 9802N 9110E (Noranda), bearing of the trench 062 degrees
Dimensions: 3.5 X 0.75 X 0.5 metres exposing approximately 1.25 metres of bedrock
Exposure was of a sheared zone within the siltstone with a graphite and quartz rich core
Rock samples TJR - 3, 4, 5

Trench #2 - dug to expose a weak anomaly in an arsenic anomaly with a gold anomaly in the immediate area.

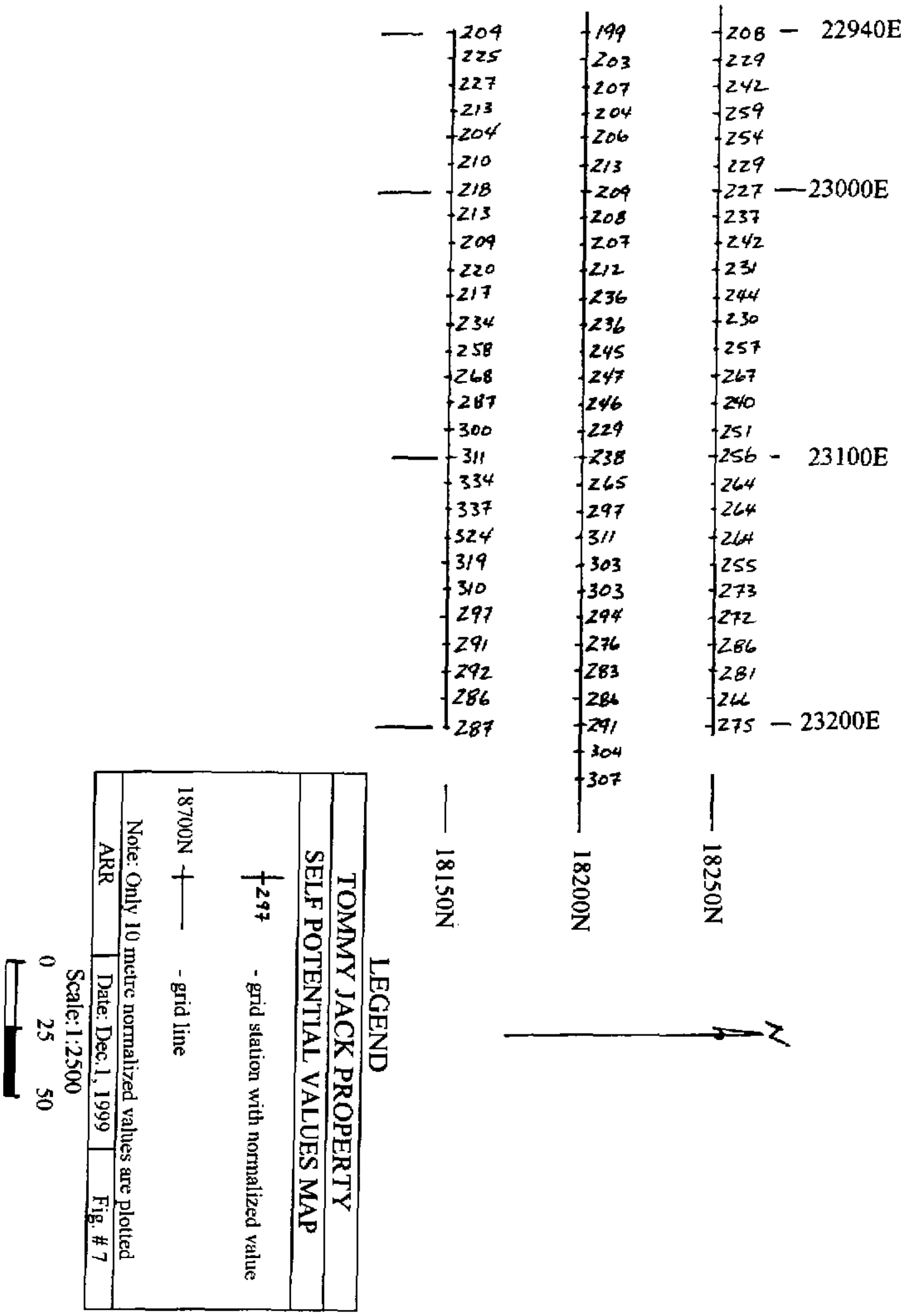
Co-ordinates: 18470N 21142E, Bearing of trench 250 degrees
Dimensions: 6.0 X 0.5 X 0.5 metres, exposing approximately 5.0 metres of bedrock
Exposure was of quartz-carbonate veined siltstone with a small right lateral fault at the west end of sample TJR - 17. Rock samples TJR - 17 to 22

Trench # 3 - dug to expose a newly discovered quartz vein in sandstone located on the northeast flank of Moret Ridge.

Co-ordinates: approx. 17900N 21421E, Bearing of trench 080 degrees
Dimensions: 2.5 X 0.5 X 0.75 metres, exposing approx. 1.25 metres of bedrock
Exposure (outcrop) of a quartz vein in the sandstone. Sample # TJR - 31, 32, 33

Numerous pits were dug in the areas of the various SP anomalies but very few exposed any bedrock. Some of these pits did expose bedrock in areas outside the anomaly areas and these exposures were sampled if any sign of mineralizaton was observed.

SELF POTENTIAL SURVEY EAST SIDE OF UNNAMED CREEK



DISCUSSION OF RESULTS

Self Potential Survey

The SP survey generated several anomalies in the main target area, some of which are coincident with the VLF anomalies generated by the Intertech surveys. The contoured values of the data indicate the location of one of the main structures as well as other structures and / or sulphide/graphite zones and /or rock units. The S.P. correlated very well with the previous V.L.F. survey done by Intertech Minerals (fig. #5) The accuracy of the SP survey determined the precise location of the anomaly thus indicating the best target area for a hand trench. The hand trenching was successful in locating the anomaly in the area of 6800N 9100E (Noranda) which was graphite and sulphides in a shear zone. The results of the survey indicate that the self potential electrical geophysical method is a useful exploration tool in this area. It generated a series of anomalies that are parallel to the principal structures as interpreted from the air photos and delineated a graphite rich zone that is anomalous in gold and pathfinder elements. It should be noted that the majority of high grade floats found on this property contain graphite.

All of these anomalies, except 7 and 8, are open to the north. These anomalies are all sub-parallel to one another and I believe they are structurally related. I also interpret that a fault, bearing 133 degrees from 18300N 21610E to 18800N 21140E, has affected the anomalies. This structure has terminated anomalies 2, 3 and 4 on the south and also displaced 1 on the south end. The anomalies are also coincident or nearly so, with the previous VLF anomalies (Intertech). These anomalies may outline a wide shear zone in the sedimentary rocks. The wide spacing of the grid lines between 18400N and 18700N makes the "tying together " of the line to line values uncertain but the anomalies are still in the immediate area even if they turn out not to be not exactly as interpreted.

The high normalization value, -200mV used because of the graphitic zone, may have distorted the plotted values but does not affect the interpretation of the anomalies. The normalized values in the -300 to -400 mV range may indicate sulphides not graphite.

The survey appears to have been set up in an anomalous area so that we may have been detecting anomalies within an anomaly which would further complicate the interpretation of the data.

I have noted that while "potting around" the near surface narrow graphite zone one gets relatively large fluctuations in the readings over very short distances, for example, 10 to 30mV over a distance of 15 to 25 cm. In this survey the graphite zone was only 10 to 25 cm wide covered by 0.5m of overburden and the readings varied by 30 to 40 mV over less than 0.5 metres. The graphite readings were in the -450 to -520mV range relative to the base station value of 0 mV in the test area of the Tommy Jack survey. The more gradual change in values such as 100mV over 40 to 50 metres may indicate sulphide veins and not graphite.

Note: The survey conducted east of Unnamed Creek is too small to be of any practical use until it is expanded.

Boulder trains

The physical location of the floats found on the property was something of a puzzle because of the dispersion pattern. This pattern consisted of large floats being topographically downslope from smaller pieces but I could not find, after concentrated effort, any sign of a source for these mineralized floats upslope from their location. I traced a boulder train on one of the upper fault blocks in very shallow overburden thereby realizing that the floats had been transported south. This southerly moving ice transported the floats uphill and subparallel to the east scarp of Moret Ridge and is the source of the scattered "lonely" floats found on the ridge and on the eastern talus slopes. This also helps explain the location of the large floats (up to 1 metre) at the base of the scarps and down-ice from the soil, VLF and SP anomalies.

Rock Samples

There have been many rock samples, primarily floats but of very local origin, that are of excellent grade found throughout the property. The grades range from .2 to 2.1 oz/ton gold and .3 to 74 oz/ton silver. These rocks are usually quartz and sulphide rich but the quartz can be sulphide poor and still carry excellent gold grades (Noranda/Intertech data). The floats can be found in most drainage patterns within the target areas as well as scattered within the overburden. These floats are found in an area from just west of Beaver Creek to east of Unnamed Creek, a distance of approximately 3 kilometres. This wide area that contains the floats also crosses the strike of the structures and includes the geophysical and geochemical anomalies.

Structures

Extensional tectonics generated multiple subparallel faults in a northwest to northerly direction as well as faults in northeast to easterly direction. The faulting dropped each block as one goes from west to east. This interpretation is based on drill sections, air photo lineaments, topography and my own experience on the ground. I believe that there are a series of subparallel faults with a NNW strike that cross the property and are subparallel to or a splay of the major Sicintine fault zone which is just to the east. There are also indications of fault zones at almost right angles to the main fault zone as indicated by the drainage pattern of the bottom of Unnamed Creek, the strike of a dacite dike in Unnamed Creek and an airphoto lineaments on the southeast corner of the area. The fault mapped by Allen (NNE trending) goes from the headwaters area of Beaver Creek towards the area of Noranda's most intense drilling. This NNE trending fault (Allen's) may also be the reason for the fragmentation and deflection of the soil and VLF anomalies in the upper area of Beaver Creek. These fault zones provided conduits and areas of weakness for the penetration of the intrusive bodies and the mineralizing solutions. Multiple episodes of fracturing resulted in the rock units becoming receptive to mineralization in both the sediments and the intrusive bodies.

Mineralization

The mineralization consists of pyrite, arsenopyrite, galena, sphalerite, tetrahedrite and chalcopyrite primarily in a quartz or quartz-carbonate altered rock. The mineralization is related to dykes and/or fault structures, it is emplaced in veins, veinlets and/or stockworks and carries values in gold and silver. The alteration consists of qtz-carbonate (ankerite, calcite, dolomite) serecite and chlorite (mafic minerals in the granodiorite dykes). The dykes themselves show alteration (clay minerals, carbonate and sericite) and contain stockworks of mineralized quartz. The sandstones, being more permeable, show the greatest degree of carbonate alteration with ankerite, calcite and qtz-carbonate forming veins and fracture fillings. The carbonate alteration zone mapped to date is approximately 2 km. X 3.5 km. and open to the southeast. In Allen's report for Intertech (1989) his statistical analysis indicates that there are at least two populations of mineralization thus suggesting at least two mineralizing pulses and possible overprinting of alteration/mineralization.

Ice Movement

The 1999 program supports the interpretation of a southerly movement of the glacial ice on the Tommy Jack property. The interpretation of transported soil anomalies is supported by the data collected by the tracing of boulder trains, the exposure of bedrock by hand trenching of the soil anomalies and the analytical data. There is no obvious evidence that this transport of soil anomalies was of any significant distance and that all the source rocks are therefore in the immediate vicinity.

Soil Anomalies

The soil anomalies generated by Noranda and Intertech should be re-interpreted in light of the probable transport and smearing of soils by glacial action.

REFERENCES

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Eisbacher, G. H. (1977). Mesozoic-Tertiary Basin Models for the Canadian Cordillera and Their Geological Constants. Can. Jour. of Earth Sciences, Vol. 14, pp. 2414 - 2421

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STATEMENT OF COSTS

TOMMY JACK PROPERTY 1999 SEASON

WAGES	
A. Raven 39 days @ $225/day July 5 to August 12 inclusive	$8775.00
N. Raven 33 days @ $150/day (assistant) July 7 to August 11 inclusive	$4950.00
CAMP ACCOMMODATION and SUPPLIES	
64 man/days @ $60/day includes all expendable supplies, equipment and accommodation	$3840.00
SERVICES	
Helicopter charter - Canadian Helicopter of Smithers	$2979.78
Analytical services - Chemex Labs	$855.73
Expediting services	$385.00
TRAVEL EXPENSES	
Round trip from Pender Harbour to Smithers	$903.85
REPORT	$2115.00
TOTAL COSTS	**$24,804.36**

STATEMENT OF QUALIFICATIONS

1969 - 73 --------- Mineral Exploration

-geochemical surveys, geophysics, prospecting in B.C.

1973 - 74 --------- Mineral Exploration

-geochemical surveys, geophysics, diamond drilling in Australia

1974 to Present -- Mineral Exploration

-geochemical surveys., geophysical surveys, geological mapping, prospecting, crew training and exploration project management in B.C. and the Western U.S.A.

(Washington,California,Nevada,Arizona,Utah)

EDUCATION in GEOLOGY

1977 Prospector's Course - College of New Caledonia - Prince George B.C.

1977 Advanced Prospector's Course - Selkirk College - Castlegar B.C.

1986 Advanced Prospector's Course - Malaspina College - Nanaimo B.C.

1988 Exploration Geochemistry - NWFMA and Association of Exploration Geochemists - Spokane Washington U.S.A.

1990 Petrology for Prospectors - Dr. T. Richards - Smithers B.C.

1997 Tropical Geochemistry - MDRU Short Course - Vancouver B.C.

1998 MDRU Short Courses

- Mineral Exploration and Community Relations in Latin America
- Satellite and Topographical Images and Their Stuctural Analysis in Mineral Exploration

Alan R. Raven

December 1999

APPENDIX 1
ANALYTICAL RESULTS

Chemex Labs Ltd.
Analytical Chemists * Geochemists * Registered Assayers
212 Brooksbank Ave., North Vancouver
British Columbia, Canada V7J 2C1
PHONE: 604-984-0221 FAX: 604-984-0218

To: RAVEN, ALAN

BOX 80
GARDEN BAY, BC
V0N 1S0

A9926990

Comments: ATTN: ALAN RAVEN

CERTIFICATE A9926990

(LVI) - RAVEN, ALAN

Project: T.V.
P.O. # :

Samples submitted to our lab in Vancouver, BC.
This report was printed on 09-SEP-1999.

SAMPLE PREPARATION

CHEMEX CODE	NUMBER SAMPLES	DESCRIPTION
205	35	Geochem ring to approx 150 mesh
226	35	0-3 Kg crush and split
3202	35	Rock - save entire reject
229	35	ICP - AQ Digestion charge

* NOTE 1:

The 32 element ICP package is suitable for trace metals in soil and rock samples. Elements for which the nitric-aqua regia digestion is possibly incomplete are: Al, Ba, Be, Ca, Cr, Ga, K, La, Mg, Na, Sr, Ti, Tl, W.

ANALYTICAL PROCEDURES

CHEMEX CODE	NUMBER SAMPLES	DESCRIPTION	METHOD	DETECTION LIMIT	UPPER LIMIT
983	35	Au ppb: Fuse 30 g sample	FA-AAS	5	10000
2118	35	Ag ppm: 32 element, soil & rock	ICP-AES	0.2	100.0
2119	35	Al %: 32 element, soil & rock	ICP-AES	0.01	15.00
2120	35	As ppm: 32 element, soil & rock	ICP-AES	2	10000
557	35	B ppm: 32 element, rock & soil	ICP-AES	10	10000
2121	35	Ba ppm: 32 element, soil & rock	ICP-AES	10	10000
2122	35	Be ppm: 32 element, soil & rock	ICP-AES	0.5	100.0
2123	35	Bi ppm: 32 element, soil & rock	ICP-AES	2	10000
2124	35	Ca %: 32 element, soil & rock	ICP-AES	0.01	15.00
2125	35	Cd ppm: 32 element, soil & rock	ICP-AES	0.5	500
2126	35	Co ppm: 32 element, soil & rock	ICP-AES	1	10000
2127	35	Cr ppm: 32 element, soil & rock	ICP-AES	1	10000
2128	35	Cu ppm: 32 element, soil & rock	ICP-AES	1	10000
2150	35	Fe %: 32 element, soil & rock	ICP-AES	0.01	15.00
2130	35	Ga ppm: 32 element, soil & rock	ICP-AES	10	10000
2131	35	Hg ppm: 32 element, soil & rock	ICP-AES	1	10000
2132	35	K %: 32 element, soil & rock	ICP-AES	0.01	10.00
2151	35	La ppm: 32 element, soil & rock	ICP-AES	10	10000
2134	35	Mg %: 32 element, soil & rock	ICP-AES	0.01	15.00
2135	35	Mn ppm: 32 element, soil & rock	ICP-AES	5	10000
2136	35	Mo ppm: 32 element, soil & rock	ICP-AES	1	10000
2137	35	Na %: 32 element, soil & rock	ICP-AES	0.01	10.00
2138	35	Ni ppm: 32 element, soil & rock	ICP-AES	1	10000
2139	35	P ppm: 32 element, soil & rock	ICP-AES	10	10000
2140	35	Pb ppm: 32 element, soil & rock	ICP-AES	2	10000
551	35	S %: 32 element, rock & soil	ICP-AES	0.01	5.00
2141	35	Sb ppm: 32 element, soil & rock	ICP-AES	2	10000
2142	35	Sc ppm: 32 elements, soil & rock	ICP-AES	1	10000
2143	35	Sr ppm: 32 element, soil & rock	ICP-AES	1	10000
2144	35	Ti %: 32 element, soil & rock	ICP-AES	0.01	10.00
2145	35	Tl ppm: 32 element, soil & rock	ICP-AES	10	10000
2146	35	U ppm: 32 element, soil & rock	ICP-AES	10	10000
2147	35	V ppm: 32 element, soil & rock	ICP-AES	1	10000
2148	35	W ppm: 32 element, soil & rock	ICP-AES	10	10000
2149	35	Zn ppm: 32 element, soil & rock	ICP-AES	2	10000

Chemex Labs Ltd.

Analytical Chemists * Geochemists * Registered Assayers

212 Brooksbank Ave., North Vancouver
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PHONE: 604-984-0221 FAX: 604-984-0218

To: RAVEN, ALAN ##

BOX 80
GARDEN BAY, BC
V0N 1S0

Project : T.V.
Comments: ATTN: ALAN RAVEN

Certificate Date: 09-SEP-1999
Invoice No. : I9926990
P.O. Number :
Account : LVI

CERTIFICATE OF ANALYSIS A9926990

SAMPLE	PREP CODE		Au ppb FA+AA	Ag ppm	Al %	As ppm	B ppm	Ba ppm	Be ppm	Bi ppm	Ca %	Cd ppm	Co ppm	Cr ppm	Cu ppm	Fe %	Ga ppm	Hg ppm	K %	La ppm	Mg %
TJR-1	205	226	< 5	< 0.2	0.75	< 2	< 10	130	< 0.5	< 2	1.73	< 0.5	4	63	1	2.61	< 10	< 1	0.31	10	0.13
TJR-2	205	226	85	0.4	1.04	240	< 10	120	< 0.5	< 2	0.07	< 0.5	20	11	70	2.59	< 10	< 1	0.30	10	0.02
TJR-3	205	226	195	0.2	0.67	162	< 10	70	< 0.5	< 2	0.04	< 0.5	5	123	13	1.32	< 10	< 1	0.22	< 10	0.01
TJR-4	205	226	100	0.2	1.12	248	< 10	80	< 0.5	< 2	0.01	< 0.5	16	11	96	3.03	< 10	< 1	0.31	10	0.02
TJR-5	205	226	15	0.6	0.77	394	< 10	80	< 0.5	< 2	2.30	1.0	10	49	39	3.70	< 10	< 1	0.41	< 10	0.54
TJR-6	205	226	< 5	0.2	0.70	38	< 10	60	< 0.5	< 2	1.02	< 0.5	13	17	59	6.08	< 10	< 1	0.32	10	0.41
TJR-7	205	226	< 5	0.2	2.95	32	< 10	70	< 0.5	< 2	0.72	< 0.5	24	39	36	4.78	< 10	< 1	0.15	< 10	1.31
TJR-8	205	226	< 5	< 0.2	0.73	8	< 10	130	< 0.5	< 2	1.05	< 0.5	8	38	6	2.36	< 10	< 1	0.33	10	0.06
TJR-9	205	226	< 5	< 0.2	0.32	6	< 10	50	< 0.5	< 2	0.06	< 0.5	1	228	3	1.56	< 10	< 1	0.16	< 10	0.03
TJR-10	205	226	< 5	0.2	1.82	20	< 10	70	< 0.5	< 2	0.22	< 0.5	18	23	70	4.79	< 10	< 1	0.21	< 10	0.38
TJR-11	205	226	< 5	< 0.2	0.52	32	< 10	70	< 0.5	< 2	0.01	< 0.5	8	134	28	4.80	< 10	< 1	0.21	< 10	0.05
TJR-12	205	226	< 5	< 0.2	0.66	16	< 10	60	< 0.5	< 2	6.05	< 0.5	11	33	26	5.58	< 10	< 1	0.24	< 10	0.74
TJR-13	205	226	< 5	< 0.2	0.19	< 2	< 10	10	< 0.5	< 2	0.70	< 0.5	< 1	293	1	0.90	< 10	< 1	0.08	< 10	0.03
TJR-14	205	226	< 5	0.2	0.29	< 2	< 10	20	< 0.5	< 2	14.30	< 0.5	6	1	1	11.15	< 10	< 1	0.08	< 10	2.91
TJR-15	205	226	< 5	0.2	2.56	< 2	< 10	60	< 0.5	< 2	2.19	< 0.5	18	44	57	5.49	< 10	< 1	0.15	< 10	0.73
TJR-16	205	226	< 5	0.2	2.24	6	< 10	50	< 0.5	< 2	1.65	< 0.5	14	35	42	4.39	< 10	< 1	0.10	< 10	0.68
TJR-17	205	226	< 5	1.4	0.83	66	< 10	80	< 0.5	< 2	0.13	< 0.5	18	25	300	1.23	< 10	< 1	0.25	10	0.03
TJR-18	205	226	< 5	0.2	0.81	98	< 10	70	< 0.5	< 2	0.17	< 0.5	19	64	55	3.61	< 10	< 1	0.20	< 10	0.08
TJR-19	205	226	25	0.6	0.71	132	< 10	70	< 0.5	< 2	0.33	0.5	29	58	79	5.39	< 10	< 1	0.17	< 10	0.07
TJR-20	205	226	< 5	< 0.2	0.69	88	< 10	70	< 0.5	< 2	0.24	< 0.5	22	78	15	5.25	< 10	< 1	0.19	< 10	0.06
TJR-21	205	226	< 5	0.2	0.42	66	< 10	60	< 0.5	< 2	0.42	< 0.5	17	59	19	6.04	< 10	< 1	0.12	< 10	0.08
TJR-22	205	226	< 5	< 0.2	0.15	12	< 10	30	< 0.5	< 2	0.04	< 0.5	4	217	9	7.47	< 10	< 1	0.03	< 10	0.08
TJR-23	205	226	< 5	0.2	0.43	34	< 10	50	< 0.5	< 2	0.06	< 0.5	14	51	7	9.86	< 10	< 1	0.13	< 10	0.07
TJR-24	205	226	< 5	0.2	2.20	16	< 10	100	< 0.5	< 2	1.70	< 0.5	14	28	62	4.87	< 10	< 1	0.19	10	0.75
TJR-25	205	226	< 5	0.2	1.90	16	< 10	110	< 0.5	< 2	2.06	< 0.5	17	27	51	4.54	< 10	< 1	0.21	10	0.48
TJR-26	205	226	< 5	0.2	3.49	8	< 10	80	< 0.5	< 2	0.14	< 0.5	17	27	47	5.76	10	< 1	0.14	10	1.42
TJR-27	205	226	< 5	2.6	0.66	30	< 10	100	< 0.5	< 2	2.54	3.0	4	73	24	2.32	< 10	< 1	0.34	< 10	0.55
TJR-28	205	226	< 5	0.2	0.54	62	< 10	60	< 0.5	< 2	0.02	< 0.5	23	32	35	6.02	< 10	< 1	0.24	10	0.06
TJR-29	205	226	< 5	0.4	2.03	40	< 10	80	< 0.5	< 2	0.11	< 0.5	25	12	51	4.55	< 10	< 1	0.18	10	0.43
TJR-30	205	226	< 5	< 0.2	0.96	8	< 10	90	< 0.5	< 2	0.01	< 0.5	21	22	109	5.36	< 10	< 1	0.15	< 10	0.04
TJR-31	205	226	< 5	0.4	0.48	70	< 10	60	< 0.5	< 2	0.59	0.5	24	43	48	6.54	< 10	< 1	0.12	< 10	0.08
TJR-32	205	226	< 5	0.4	0.32	24	< 10	50	< 0.5	< 2	3.79	< 0.5	10	201	3	5.34	< 10	< 1	0.09	< 10	0.35
TJR-33	205	226	< 5	< 0.2	0.14	64	< 10	30	< 0.5	< 2	0.66	< 0.5	1	262	1	2.88	< 10	< 1	0.03	< 10	0.05
TJR-34	205	226	< 5	< 0.2	0.79	2	< 10	150	< 0.5	< 2	1.10	< 0.5	5	48	6	2.39	< 10	< 1	0.27	10	0.05
TJR-35	205	226	< 5	< 0.2	0.65	< 2	< 10	120	< 0.5	< 2	1.57	< 0.5	4	39	4	2.31	< 10	< 1	0.24	10	0.05

CERTIFICATION: ____________

Chemex Labs Ltd.

Analytical Chemists * Geochemists * Registered Assayers

212 Brooksbank Ave., North Vancouver
British Columbia, Canada V7J 2C1
PHONE: 604-984-0221 FAX: 604-984-0218

To: RAVEN, ALAN

BOX 80
GARDEN BAY, BC
V0N 1S0

Project : T.V.
Comments: ATTN: ALAN RAVEN

Certificate Date: 09-SEP-1999
Invoice No. : I9926990
P.O. Number :
Account : LVI

CERTIFICATE OF ANALYSIS A9926990

SAMPLE	PREP CODE		Mn ppm	Mo ppm	Na %	Ni ppm	P ppm	Pb ppm	S %	Sb ppm	Sc ppm	Sr ppm	Ti %	Tl ppm	U ppm	V ppm	W ppm	Zn ppm
TJR-1	205	226	1855	2	0.05	1	800	< 2	0.04	< 2	1	38	< 0.01	< 10	< 10	5	< 10	24
TJR-2	205	226	1490	2	0.04	9	860	20	0.01	< 2	10	101	< 0.01	< 10	< 10	14	< 10	30
TJR-3	205	226	380	3	0.03	4	410	10	0.16	< 2	3	40	< 0.01	< 10	< 10	10	< 10	10
TJR-4	205	226	1095	10	0.06	11	480	10	< 0.01	< 2	8	27	< 0.01	< 10	< 10	15	< 10	28
TJR-5	205	226	805	4	0.03	8	650	32	1.11	< 2	2	86	< 0.01	< 10	< 10	9	< 10	108
TJR-6	205	226	1160	1	0.02	12	760	< 2	0.06	< 2	8	39	< 0.01	< 10	< 10	12	< 10	34
TJR-7	205	226	840	1	0.08	24	850	< 2	0.01	< 2	6	46	< 0.01	< 10	< 10	72	< 10	116
TJR-8	205	226	1010	3	0.05	4	740	2	0.13	< 2	3	16	< 0.01	< 10	< 10	6	< 10	46
TJR-9	205	226	445	3	0.01	4	260	< 2	0.03	< 2	1	4	< 0.01	< 10	< 10	4	< 10	12
TJR-10	205	226	605	< 1	0.06	19	450	2	0.09	< 2	8	36	< 0.01	< 10	< 10	50	< 10	82
TJR-11	205	226	445	1	0.03	8	460	2	0.08	< 2	4	39	< 0.01	< 10	< 10	12	< 10	48
TJR-12	205	226	1580	3	0.04	19	520	< 2	0.03	< 2	5	79	< 0.01	< 10	< 10	16	< 10	22
TJR-13	205	226	175	5	0.01	5	100	< 2	< 0.01	< 2	< 1	7	< 0.01	< 10	< 10	5	< 10	< 2
TJR-14	205	226	3280	< 1	< 0.01	6	70	4	< 0.01	< 2	3	237	< 0.01	< 10	< 10	20	< 10	32
TJR-15	205	226	1160	2	0.09	17	470	4	0.02	< 2	8	37	< 0.01	< 10	< 10	48	< 10	90
TJR-16	205	226	960	1	0.10	14	510	4	< 0.01	< 2	8	40	< 0.01	< 10	< 10	48	< 10	78
TJR-17	205	226	400	< 1	0.07	12	430	< 2	0.01	< 2	5	30	< 0.01	< 10	< 10	13	< 10	2
TJR-18	205	226	1140	3	0.07	16	670	2	< 0.01	< 2	8	55	< 0.01	< 10	< 10	17	< 10	16
TJR-19	205	226	1730	1	0.07	34	860	2	0.03	< 2	15	37	< 0.01	< 10	< 10	26	< 10	34
TJR-20	205	226	1965	3	0.06	23	780	2	< 0.01	< 2	11	37	< 0.01	< 10	< 10	17	< 10	26
TJR-21	205	226	2290	1	0.05	20	690	2	0.01	< 2	11	30	< 0.01	< 10	< 10	13	< 10	30
TJR-22	205	226	2070	3	0.02	6	180	2	< 0.01	< 2	5	15	< 0.01	< 10	< 10	13	< 10	34
TJR-23	205	226	1835	< 1	0.04	15	550	6	< 0.01	< 2	7	9	< 0.01	< 10	< 10	15	< 10	52
TJR-24	205	226	1170	1	0.06	12	970	< 2	< 0.01	< 2	6	41	< 0.01	< 10	< 10	39	< 10	108
TJR-25	205	226	1135	1	0.07	15	1730	2	0.01	< 2	6	39	< 0.01	< 10	< 10	40	< 10	120
TJR-26	205	226	685	< 1	0.05	17	730	2	< 0.01	< 2	6	13	< 0.01	< 10	< 10	89	< 10	114
TJR-27	205	226	1025	2	0.02	3	580	288	0.54	< 2	1	74	< 0.01	< 10	< 10	3	< 10	282
TJR-28	205	226	1520	< 1	0.03	17	1150	2	< 0.01	< 2	8	32	< 0.01	< 10	< 10	24	< 10	90
TJR-29	205	226	695	< 1	0.10	20	520	2	< 0.01	< 2	8	38	< 0.01	< 10	< 10	32	< 10	80
TJR-30	205	226	415	< 1	0.05	24	550	4	< 0.01	< 2	7	141	< 0.01	< 10	< 10	53	< 10	116
TJR-31	205	226	1480	2	0.06	34	700	12	< 0.01	< 2	15	31	< 0.01	< 10	< 10	27	< 10	70
TJR-32	205	226	3160	5	0.04	12	420	4	< 0.01	< 2	8	46	< 0.01	< 10	< 10	22	< 10	40
TJR-33	205	226	825	5	0.02	7	300	< 2	0.01	< 2	1	23	< 0.01	< 10	< 10	9	< 10	20
TJR-34	205	226	775	3	0.09	1	930	< 2	0.08	< 2	2	42	< 0.01	< 10	< 10	7	< 10	42
TJR-35	205	226	705	1	0.08	1	890	6	0.07	< 2	2	33	< 0.01	< 10	< 10	6	< 10	68

CERTIFICATION: ______________

APPENDIX 2
SELF POTENTIAL DATA

SELF POTENTIAL DATA

PROJECT: Tommy Jack '99

Page 1

COMMENTS: START AT NOREX 6800N 9000E, TEST MASSIVE SULPHIDE VEIN IN SANDSTONE

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value mV	Final Value (plot)	Comments
6800N	9000E	∅	0.6 mV	∅	∅	∅	-200	-200	
	10	-26		-26		-26	-200	-226	
	20	-44				-44	-200	-244	
	30	-135				-135	-200	-335	
	40	-178				-178	-200	-378	anomaly (not graphite?)
	9050E	-103				-103	-200	-303	not trenched in 1999
	60	-51				-51	-200	-251	
	70	-63				-63	-200	-263	
	80	-56				-56	-200	-256	
	90	-91				-91	-200	-291	
	9100E	-111				-111	-200	-311	
	10	-387				-387	-200	-587	graphite (STRUCTURE)
	20	-76				-76	-200	-276	
	30	+9				+9	-200	~~10~~ -191	
	40E	-36				-36	-200	-236	
DETAIL READINGS									
6800N	9098E	-118				-118	-200	-318	
	9100	-146				-146	-200	-346	
	9110	-389				-389	-200	-589	
	9114E	-115				-115	-200	-315	
	9107E	-182				-182	-200	-382	
	08	-262				-262	-200	-462	
	9109	-291				-291	-200	-491	
	9110	-386				-386	-200	-586	
	9112	-453				-453	-200	-653	
	9113E	-333				-333	-200	-533	
6799N	9110E	-320				-320	-200	~~3~~ -520	
	9112E	-450				-450	-200	-650	
6801N	9110E	-424				-424	-200	-624	
	9112E	-478				-478	-200	-678	
6802N	9111E	-458				-458	-200	-658	}
	9111.5	-486				-486	-200	-686	} HAND TRENCH AREA
	9112	-428				-428	-200	-628	} SAMPLE # TJ. R-2,3,4
	9112.5	-459				-459	-200	-659	}
	9113	-435				-435	-200	-635	}
	9113.5	-384				-384	-200	-584	}
	~~9114~~								

Additional comments:

NOT TIED TO LARGER SURVEY, THE SAME NORMALIZER VALUE (-200 mV) IS USED
GRANITE HAS MASKED SULPHIDE VEIN, ALL STATIONS WERE RUN FROM THE
SAME BASE STATION @ 6800N 9000E.

Anomaly @ 6800N 9040E probably not graphite (numbers too low) not recognized in field, not trenched.

SELF POTENTIAL DATA

PROJECT: TOMMY JACK '99

Page 2

COMMENTS: PART OF TEST GRID (6800N 9000E NORTH) USING B.S. AT 6800N-9600E

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
6775N	9000E	-24	0.6mV	-24	Ø	-24	-200	-224	
	10	-41				-41	↑	-241	
	20	-57				-57		-257	
	30	-83				-83		-283	
	40	-149				-149		-349	anomaly
	9050E	-126				-126		-326	
	60	-62				-62		-262	
	70	-45				-45		-245	
	80	-59				-59		-259	
	90	-90				-90		-290	
	9100E	-191				-191		-391	
	10	-520.				-520		-720	graphite
	20	-42				-42		-242	
	30	+11				+11	↓	-189	
	40	+15				+15	-200	-185	
DETAIL READINGS									
6775N	9003	-205	0.6	-205	Ø	-205	-200	-405	
	04	-235				-235	↑	-435	
	05	-255				-255		-455	
	06	-312				-312		-512	
	07	-365				-365		-565	
	08	-426				-426		-626	
	09	-493				-493		-693	
	9110E	-520				-520		-720	
	11	-482				-482		-682	
	12	-425				-425		-625	
	13	-327				-327		-527	
	14	-229				-229	↓	-429	
	9115E	-163				-163	-200	-363	

Additional comments:

SELF POTENTIAL DATA

PROJECT: Tammy Jack '99

COMMENTS: Part of Test Grid (6800N · 9000E Norex) using B.S. at 6800N · 9000E

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
6825N	9000E	-27	0.6	-27	Ø	-27	-200	-227	
	10	-67				-67	↑	-267	
	20	-98				-98		-298	
	30	-185				-185		-385	} anomaly graphite??
	40	-239				-239		-439	
	9050E	-146	0.6	-146	Ø	-146		-346	
	60	-50				-50		-250	
	70	-41				-41		-241	
	80	-61				-61		-261	
	90	-123				-123		-323	
	9100E	-322				-322		-522	graphite value
	10	-218				-218		-418	
	20	-63				-63	↓	-263	
	30	-34				-34	-200	-234	
Detail Readings									
6825N	9100E	-322	0.6	-322	Ø	-322	-200	-522	
	01	-393				-393	↑	-593	} graphite values
	02	-460				-460		-660	
	03	-517				-517		-717	
	04	-519				-519		-719	
	9105E	-493				-493		-693	
	06	-426				-426	↓	-626	
	07	-360				-360	-200	-560	

Additional comments:

SELF POTENTIAL DATA

PROJECT: Tommy Jack '99

COMMENTS: Baseline Brg 170° Start At 18900N Z1300E

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
BaseLine	∅	—	0.5mV		∅			-200	L-18900N Z1300E
	0+25	-17		-17		-17	-200	-217	
	0+50	-11		-11		-11	-200	-211	
	0+67	+20		+20		+20	-200	-180	L-18800N Z1310E
	0+75	-5		-5		-5	-200	-205	
	1+00S	+6	Not	+6		+6	-200	-194	
	1+25	+12	Calculated	+12		+12	-200	-188	
	1+50	+12		+12		+12	-200	-188	
	1+75	+10		+10		+10	-200	-190	L-18700N Z1330E
	2+00S	+20		+20		+20	-200	-180	
	2+25	+7		+7		+7	-200	-193	
	2+50	-8		-8		-8	-200	-208	
	2+75	+1		+1		+1	-200	-199	
	2+80S	+9		+9	∅	+9	-200	-191	L-18600N Z1330E
	New Set-up		Starting At			2+80S	Base station value		∅+(+9) = +9
B.L	3+00S	+8	0.5mV	+8	+9	+17	-200	-183	
	3+25	+17		+17	+9	+26	-200	-174	
	3+50	+16	Not	+16	+9	+25	-200	-175	
	3+75	+21	Calculated	+21	+9	+30	-200	-170	
	4+00S	+36		+36	+9	+45	-200	-155	
	4+25	+39		+39	+9	+48	-200	-152	
	4+50	+53		+53	+9	+62	-200	-138 -138	
	4+58	+53		+53	+9	+62	-200	-138 -138	L-18500N Z1400E (South 185N. Line
	4+75	+56		+56	+9	+65	-200	-135	
	5+00S	+66		+66	+9	+75	-200	-125	
	5+25	+71		+71	+9	+80	-200	-120	
	5+50	+75		+75	+9	+84	-200	-116	
	5+75	+75		+75	+9	+84	-200	-116	
	New Set-up			Starting At		5+75S	Base station value		+9+(+75) = +84
B.L.	5+82	+6	0.5mV	+6	+84	+90	-200	-110	L-18300N Z1460E
	6+00S	+7	Not	+7	+84	+91	-200	-109	
	6+25	+10	Calculated	+10	+84	+94	-200	-106	
	6+50	+8		+8	+84	+92	-200	-108	
	6+75S	+2		+2	+84	+86	-200	-114	L-18200N Z1480E

Additional comments:

Stations At 25 m. Interval Plus Where Grid Lines Are Crossed

Pot Correction of +0.5mV Has No Practical Value So Is Not Included In The Value Calculations.

SELF POTENTIAL DATA

PROJECT: Tommy Jack '99 Page 5

COMMENTS: L-18900N (WEST HALF) ORIGINAL "0" VALUE BASE STATION (18900N 21300E)
"BARE POT"

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
18900N	21300E	∅	0.5	∅	∅	∅	-200	-200	
	290	-8	↑		↑	-8	↑	-208	
	280	-22				-22		-222	
	270	-30				-30		-230	
	260	-82				-82		-282	
	250	-61	TOO SMALL			-61		-261	
	240	-78				-78		-278	
	230	-191				-191		-391	
	220	-229				-229		-429	anomaly graphite?
	210	-174				-174		-374	
	21200E	-114				-114		-314	
	190	-89	NOT CALCULATED			-89		-289	
	180	-81				-81		-281	
	170	-109				-109		-309	
	160	-145				-145		-345	
	150	-181				-181		-381	
	140	-216				-216		-416	anomaly
	130	-106 (-16)				-106 (-16)		-306 (-216)	-possible notes error
	120	-110				-110		-310	geological contact
	110	+132				+132		-68	area?
	21100	+126				+126		-74	
	090	+131				+131		-69	
	080	+133				+133		-67	
	070	+133	↓		↓	+133	↓	-67	
	21060E	+131	0.5		∅	+131	-200	-69	
DETAIL READINGS									
L-18900N	21213	-170				-170	-200	-370	
	214	-187				-187	↑	-387	
	215	-176				-176		-376	
	216	-183				-183		-383	
	217	-192				-192		-392	
	218	-209				-209		-409	
	219	-216				-216		-416	
	220	-229				-229		-429	
	221	-230				-230		-430	
	222	-237				-237		-437	
	223	-252				-252		-452	
	224	-255				-255		-455	
	225	-247				-247		-447	
	226	-234				-234	↓	-434	
	227	-216				-216		-416	
	228	-189				-189	-200	-389	

Additional comments: additional detail readings taken between 21222E and 21226E (15 readings) in field notes. to determine trend trench area.
-18900N 21130E probable error in notes reading should probably be -106 Not -016
detail readings do not support the -016 value. does support -106 reading.

SELF POTENTIAL DATA

PROJECT: Tommy Jack '99 — Page 6

COMMENTS: Detail 18900N Z1100E Area and Comparison of "Bare Pot" + "Canvas Bag"

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
		B.P. / C.B		C.B. only		C.B. only			
L 18900N	Z1180E		+3mV		-81		-200	-281	
	170	-20/-12		-9		-90		-290	
	160	-59/-44		-41		-122		-322	
	150	-92/-94		-91		-172		-372	
	140	-128/-131		-128		-209		-409	
	130	+68/+56		+59		-22		-222	geological contact area?
	120	+197/+190		+193		+112		-88	
	110	+219/+208		+211		+130		-70	
	Z1100E	+216/+215		+218		+137		-63	
	090	+222/+224		+227		+146		-54	
	080	+226/+230		+233		+152		-48	
	070	+223/+230		+233		+152		-48	
	060	+221/+230		+233		+152		-48	
	050	+227/+230		+233		+152		-48	
	040	+237/+229		+232		+151		-49	
	030	+196/+228		+231		+150		-50	
18900N	Z1020E	N.R./+210	+3mV	+213	-81	+132	-200	-68	
18900N	Z1136E	-55	+3	-52	-81	-133	-200	-333	
	137	-74		-71		-152		-352	
	138	-95		-92		-173		-373	
	139	-116		-113		-194		-394	
	Z1140E	-161		-158		-239		-439	
	141	-139	+3	-136	-81	-217	-200	-417	
18990N	Z1141E	-161	+3	-158	-81	-239	-200	-439	
	142	-171		-168		-249		-449	
	143	-174		-171		-252		-452	
	144	-181		-178		-279		-479	
	146	-206		-203		-284		-484	
	147	-192		-189		-270		-470	
	148	-128		-125		-206		-406	
	149	-113		-110		-191		-391	
	Z1150E	-95	+3	-92	-81	-172	-200	-372	

AN ADDITIONAL 48 READING WERE TAKEN "POTTING" AROUND THIS ANOMALY TO ATTEMPT TO LOCATE A TRENCH SITE (see field book)

Additional comments:
B.P. reading for Bare Pot C.B. reading for "Canvas bag"
- readings at Z1080E to Z1050E are the same, pots, connections were checked and the readings redone, the readings were repeated within 1mV.

N.R. - No Reading taken

SELF POTENTIAL DATA

PROJECT: Tammy Jack '99

COMMENTS: L-18900N (EAST SIDE) "BARE POT"

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
18900N	Z1300E	ø	-3	ø	ø	ø	-200	-200	
	310	+14	↑	+11	↑	+11	↑	-189	
	320	-24		-27		-27		-227	
	330	-28		-31		-31		-231	
	340	-23		-26		-26		-226	
	350	-67		-70		-70		-270	anomaly?
	360	-46		-49		-49		-249	
	370	-102		-105		-105		-305	anomaly?
	380	-100		-103		-103		-303	
	390	-100		-103		-103		-303	
	Z1400E	-62		-65		-65		-265	
	410	-93		-96		-96		-296	
	420	-109		-112		-112		-312	
	430	-180		-183		-183		-383	
	440	-271		-274		-274		-474	graphite?
	450	-120		-123		-123		-323	
	460	-30		-33		-33		-238 -233	
	470	+6		+3		+3		-197	
	480	+62		+59		+59		-141	
	490	+63		+60		+60		-140	
	Z1500E	+60		+57		+57		-143	
	510	+90	↓	+87	↓	+87	↓	-113	
	520	+114	-3	+111	ø	+111	-200	-89	
DETAIL READINGS									
18900N	Z1433E	-272	-3	-275	ø	-275	-200	-475	
	434	-300	↑	-303	↑	-303	↑	-503	
	435	-328		-331		-331		-531	
	436	-338		-341		-341		-541	graphite?
	437	-328		-331		-331		-531	
	438	-308		-311		-311		-511	
	439	-283		-286		-286		-486	
	Z1440E	-271		-274		-274		-474	
	442	-228		-231		-231		-431	
	444	-183	↓	-186	↓	-186	↓	-386	
	446	-149	-3	-152	ø	-152	-200	-352	

Additional comments: the high readings at Z1440E area are probably related to the graphite at 6800N - 9100E which is on the same VLF anomaly as this area (Z1440E) (see discussion in report)

SELF POTENTIAL DATA

PROJECT: Tommy Jack '99

COMMENTS: L-18800N 21310E → 21 (WEST SIDE) STATION 0+67S on S.P. BASELINE
BASELINE VALUE = +20mV

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
18800N	21310E		+2		+20	+22	-200	-178	
	300	-18	↑	-16	↑	+4	↑	-196	
	290	-8		-6		+14		-186	
	280	-19		-17		+3		-197	
	270	-22		-20		∅		-200	
	260	-24		-22		-2		-202	
	21250	-85		-83		-63		-263	
	240	-198		-196		-176		-376	anomaly
	230	-108		-106		-86		-286	
	220	-86		-84		-64		-264	
	210	-88		-86		-66		-266	
	21200E	-92		-90		-70		-270	
	190	-110		-108		-88		-288	
	180	-152		-150		-130		-330	
	170	-234		-232		-212		-412	anomaly
	160	-113		-111		-91		-291 (-291)	geological contact?
	150	+34		+36		+56		-144	
	140	+58		+60		+80		-120	
	130	+81		+83		+103		-97	
	120	+78		+80		+100		-100	
	110	+97		+99		+119		-81	
	21100	+86		+88		+108	↓	-92	
	090	+94	↓	+96	↓	+116		-84	
	080	+94	+2	+96	+20	+116	-200	-84	
	DETAIL READINGS.								
18800N	21250E	-88	+2	-86	+20	-66	-200	-266	
	245	-107	↑	-105	↑	-85	↑	-285	
	242	-270		-268		-248		-448	
	240	-200		-198		-178		-378	
	235E	-126		-124		-104		-304	
	244E	-194		-192		-172		-372	
	243	-247		-245		-225		-425	
	242	-268		-266		-246	↓	-446	
	241	-271	↓	-269	↓	-249		-449	
	240.5E	-243	+2	-241	+20	-221	-200	-441	

Additional comments:

SELF POTENTIAL DATA

PROJECT: Tommy Jack '99 Page 9

COMMENTS: L-18800N Z1310E → Z1520E (EAST HALF) BASE STATION VALUE +20

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
18800N	Z1310E	/	+2		+20	+22	-200	-178	
	320	-9		-7		+13		-187	
	330	-9		-7		+13		-187	
	340	-38		-36		-16		-216	
	350	-60		-58		-38		-238	
	360	-66		-64		-44		-244	
	370	-104		-102		-82		-282	
	380	-240		-238		-216		-416	anomaly
	390	-237		-235		-215		-415	
	Z1400E	-145		-143		-123		-323	
	410	-141		-139		-119		-319	
	420	-200		-198		-178		-378	
	430	-179		-177		-157		-357	
	440	-277		-275		-255		-455	
	450	-358		-356		-336		-536	anomaly
	460	-252		-250		-230		-430	
	470	-100		-98		-78		-278	
	480	-17		-15		+5		-195	
	490	+28		+30		+50		-150	
	Z1500E	+54		+56		+76		-124	
	510	+62		+64		+84		-116	
	520	+56	+2	+58	+20	+78	-200	-122	
DETAIL READINGS									
18800N	Z1440	-277	+2	-275	+20	-255	-200	-455	
	42	-338		-336		-316		-516	
	44	-425		-423		-403		-603	
	46	-486		-484		-464		-664	
	48	-459		-457		-437		-637	graphite?
	450	-356		-354		-334		-534	
	52	-357		-355		-355		-555	
	54	-408		-406		-386		-586	
	56	-468		-466		-446		-646	
	58	-364		-362		-342		-542	
	Z1460	-251	+2	-249	+20	-229	-200	-429	

MORE DETAIL READING NEXT PAGE FOR Z1380E AREA.

Additional comments:

SELF POTENTIAL DATA

PROJECT: Tommy Jack '99

COMMENTS: Details 18800N 21380E Area And 18700N 21330E is At 1+75 S on S.P. Baseline
B.S. Value = +10

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
18800N	21370E	-102	+2	100	+20	-80	-200	-280	
	72	-111		-109		-89		-289	
	74	-128		-126		-106		-306	
	76	-141		-139		-119		-319	
	78	-187		-185		-165		-365	
	380	-238		-236		-216		-416	
	82	-279		-277		-257		-457	
	84	-314		-312		-292		-492	wide graphitic zone?!
	86	-266		-264		-244		-444	
	88	-239		-237		-217		-417	
	390	-228		-226		-206		-406	
	92	-196		-194		-174		-374	
	94	-192		-190		-170		-370	
	96	-174		-172		-152		-352	
	98	-151		-149		-129		-329	
	21400E	-140	+2	-138	+20	-118	-200	-318	
18700N	21330E		-2		+10	+8	-200	-192	
	320	+7		+5		+15		-185	
	310	+17		+15		+25		-175	
	21300E	+16		+14		+24		-176	
	290	+19		+17		+27		-173	
	280	+39		+37		+47		-153	
	270	+42		+40		+50		-150	
	260	+46		+44		+64		-136	
	250	+39		+37		+57		-143	
	240	+32		+30		+50		-150	
	230	+25		+23		+43		-157	
	220	+18		+16		+36		-164	
	210	+5		+3		+13		-187	
	21200E	-21		-23		-13		-213	anomaly
	190	-11		-13		-3		-203	
	180	+22		+20		+30		-170	
	170	+48		+46		+56		-144	
	160	+63		+61		+71		-129	
	150	+73		+71		+81		-119	
	140	+77		+75		+85		-115	
	130	+85		+83		+93		-107	
	120	+91		+89		+99		-101	
	110	+94		+92		+102		-98	
18700N	21100E	+97	-2	+95	+10	+105	-200	-95	

Additional comments:

SELF POTENTIAL DATA

PROJECT: Tommy Jack '99

COMMENTS: L-18700N Z1330E → Z1560E (EAST SIDE)
B.S. value +10 Pot Corr. -2 B.S. = 0+75S on S.P. Baseline.

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
18700N	Z1330E	—	-2	—	+10	+8	-200	-192	
	340	-17		-19		-9		-209	
	350	-39		-41		-31		-231	
	360	-54		-56		-46		-246	
	370	-68		-70		-60		-260	
	380	-106		-108		-98		-298	
	390	-155		-157		-147		-347	
	Z1400E	-237		-239		-229		-429	graphite?
	410	-247		-249		-239		-439	
	420	-145		-147		-137		-337	
	430	-103		-105		-95		-295	
	440	-100		-102		-92		-292	
	450	-109		-111		-101		-301	
	460	-146		-149		-138		-338	
	470	-284		-286		-276		-476	graphite?
	480	-177		-179		-169		-369	
	490	-194		-196		-186		-386	
	Z1500E	-63		-65		-55		-255	
	510	+18		+16		+26		-174	
	520	+44		+42		+52		-148	
	530	+57		+55		+65		-135	
	540	+74		+72		+82		-118	
	550	+72		+70		+80		-120	
18700N	Z1560E	+100	-2	+98	+10	+108	-200	-92	
DETAIL READINGS.									
18700N	Z1460	-141	-2	-143	+10	-133	-200	-333	
	62	-174		-176		-166		-366	
	64	-203		-205		-195		-395	
	66	-232		-234		-224		-424	
	68	-272		-274		-264		-464	
	470	-282		-284		-274		-474	
	72	-222		-224		-214		-414	
	74	-195		-197		-187		-387	
	76	-183		-185		-175		-375	
	78	-177		-179		-169		-369	
	Z1480	-173	-2	-175.	+10	-165	-200	-365.	

Additional comments:
realize moving pot dries out + repeatability of readings is ± 5mV, solved by wetting moving pot every 1/4 hours or so.

SELF POTENTIAL DATA

PROJECT: Tammy Jack '99. Page 12

COMMENTS: Detail 187 N Z1390E ⇒ Z1420E and L-18600N Z1330E to Z1100E (west side)
B.S. Value +9mV, Z+80S on S.P baseline.

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
18700N	Z1390E	-153	-2	-155	+10	-145	-200	-345	
	92	-162	↑	-164	↑	-154	↑	-354	
	94	-176		-178		-168		-368	
	96	-198		-200		-190		-390	
	98	-214		-216		-206		-406	
	Z1400E	-232		-234		-224		-424	
	402	-256		-257		-247		-447	
	404	-295		-297		-287		-487	graphite?
	406	-291		-293		-283		-483	
	408	-268		-270		-260		-460	
	Z1410E	-245		-247		-237		-437	
	412	-220		-222		-212		-412	
	414	-185		-187		-177		-377	
	416	-170		-172		-162		-362	
	418	-153	↓	-155	↓	-145	↓	-345	
	Z1420E	-140	-2	-142	+10	-132	-200	-332	
18600N	Z1330E		-4		+9	+5	-200	-195	
	320	+10	↑	+6	↑	+15	↑	-185	
	310	+30		+26		+35		-165	
	Z1300E	+28		+22		+31		-169	
	290	+25		+21		+30		-~~130~~ -170	
	280	+62		+58		+67		-133	
	270	+62		+58		+67		-133	
	260	+67		+63		+72		-128	
	250	+64		+60		+69		-131	
	240	+47		+43		+52		-148	
	230	+58		+54		+63		-137	
	220	+59		+55		+64		-136	
	210	+65		+61		+70		-130	
	Z1200E	+53		+49		+58		-142	
	190	+71		+67		+76		-124	
	180	+76		+72		+81		-119	
	170	+66		+62		+71		-129	
	160	+76		+72		+81		-119	
	150	+99		+95		+104		-96	
	140	+98		+94		+103		-97	
	130	+100		+96		+105		-95	
	120	+82		+78		+87		-113	
	110	+99	↓	+95	↓	+104	↓	-96	
	Z1100E	+100	-4	+96	+9	+105	-200	-95	

Additional comments:
- possible anomaly value is change of 20 ⇒ 30mV e.g. Z1120E.

SELF POTENTIAL DATA

PROJECT: Tommy Jack '99

COMMENTS: 18600N 21330E → 21560E + DETAIL.

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
18600N	21330E		-4		+9	+5	-200	-195	
	340	-8	↑	-12	↑	-3	↑	-203	
	350	-36		-40		-31		-231	
	360	-61		-65		-56		-256	
	370	-103		-107		-98		-298	
	380	-146		-150		-141		-341	
	390	-234		-238		-229		-429	anomaly?
	21400E	-201		-205		-196		-396	
	410	-122		-126		-117		-317	
	420	-135		-139		-130		-330	
	430	-128		-132		-123		-323	
	440	-130		-134		-125		-325	
	450	-190		-194		-185		-385	
	460	-261		-265		-256		-456	anomaly?
	470	-95		-99		-90		-290	
	480	-104		-108		-99		-299	
	490	-165		-169		-160		-360	anomaly?
	21500	-26		-30		-21		-221	
	510	+16		+12		+21		-179	
	520	+54		+50		+59		-141	
	530	+66		+62		+71		-129	
	540	+90		+86		+85		-115	
	550	+88	↓	+84	↓	+83	↓	-117	
	560	+83	-4	+79	+9	+88	-200	-112	
DETAIL READINGS									
18600N	21450E	-188	-4	-192	+9	-183	-200	-383	
	52	-210	↑	-214	↑	-205	↑	-405	
	54	-224		-228		-219		-419	
	56	-274		-278		-269		-469	
	458	-291		-295		-286		-486	
	460	-262		-266		-257		-457	
	62	-210		-214		-205		-405	
	64	-148		-152		-143		-343	
	66	-114	↓	-118	↓	-109	↓	-309	
	68	-92		-96		-87		-287	
	21470E	-94	-4	-98	+9	-89	-200	-289	

Additional detail readings on next page.

Additional comments:

SELF POTENTIAL DATA

PROJECT: Tammy Jack '99

COMMENTS: L-186N Detail and 18500N 21400E → 21120E

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
18600N	21380E	-146	-4	-150	+9	-141	-200	-341	
	82	-155	↑	-159	↑	-150	↑	-350	
	84	-164		-168		-159		-359	
	86	-173		-177		-178		-378	
	88	-202		-206		-197		-397	
	390	-233		-237		-228		-428	
	92	-273		-277		-268		-468	
	94	-270		-274		-265		-465	
	96	-256		-260		-251		-451	
	98	-230	↓	-234	↓	-225	↓	-425	
	21400E	-200	-4	-204	+9	-195	-200	-395	
18500N	21400E		-0.5		+62	+62	-200	-138	
	390	+10	↑		↑	+72	↑	-128	
	380	+17				+79		-121	
	370	+19				+81		-119	
	360	+29				+91		-109	
	350	+35				+97		-103	
	340	+41				+103		-97	
	330	+39				+101		-99	
	320	+41				+103		-97	
	310	+48				+110		-90	
	21300E	+48				+110		-90	
	290	+45				+107		-93	
	280	+51				+113		-87	
	270	+51	Not Calculated			+113		-87	
	260	+50				+112		-88	
	250	+44				+106		-94	
	240	+50				+112		-88	
	230	+49				+111		-89	
	220	+50				+112		-88	
	210	+46				+108		-92	
	21200E	+37				+99		-101	
	190	+48				+110		-90	
	180	+56				+118		-82	
	170	+46				+108		-92	
	160	+36				+98		-102	
	150	+17				+79		-121	anomaly?
	140	+21				+83		-117	
	130	+43	↓		↓	+105	↓	-95	
	21120E	+42	-0.5		+62	+104	-200	-96	

Additional comments:

SELF POTENTIAL DATA

PROJECT: Tommy Jack

COMMENTS: L-18500N 21400E ⇒ 21660E and Detail Readings

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
18500N	21400E		-0.5		+62	+62	-200	-138	
	410	-9	↑		↑	+53	↑	-147	
	420	-28				+34		-166	
	430	-32				+30		-170	
	440	-46				+16		-184	
	450	-72				-10		-210	
	460	-85				-23		-223	
	470	-77				-15		-215	
	480	-76				-14		-214	
	490	-115				-53		-253	
	21500E	-136				-74		-274	
	510	-193				-131		-331	
	520	-370				-308		-508	graphite?
	530	-327				-265		-465	
	540	-163				-101		-301	
	550	-153				-91		-291	
	560	-199				-137		-337	anomaly?
	570	-126				-64		-264	
	580	-24				+38		-162	
	590	+15				+77		-123	
	21600	+42				+104		-96	
	610	+58				+120		-80	
	620	+61				+123		-77	
	630	+71				+133		-67	
	640	+85				+147		-53	
	650	+81				+143		-57	
18500N	21660E	+70				+132		-68	
18500N	21550E	-155	Not Calculated			-93		-293	
	52	-156				-94		-294	
	54	-164				-102		-302	
	56	-162				-100		-300	
	58	-189				-127		-327	
	560	-199				-137		-337	
	62	-201				-139		-339	
	64	-197				-135		-335	
	66	-185				-123		-323	
	68	-155				-93		-293	
18500N	21570E	-128				-66		-266	
18500N	21520E	-369				-307		-507	
	21	-389				-327		-527	
	22	-408				-366		-566	
	23	-434				-372		-572	
	24	-437				-375		-575	
	25	-439				-377		-577	
	26	-449	↓		↓	-387	↓	-587	graphite?
18500N	21527E	-447	-0.5		+62	-385	-200	-585	

SELF POTENTIAL DATA

PROJECT: Tommy Jack '99

COMMENTS: L-18300N Z1460E ⇒ Z1160E and Z1460E ⇒
B.S. Value = +6 Pot Corr. +0.5 mV S.P. Baseline Stn B.S. = Z1460E

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
18300N	Z1460E		+0.5		+90	+90	-200	-110	
	450	+5				+95		-105	
	440	+8				+98		-102	
	430	+15				+105		-95	
	420	+21				+111		-89	
	410	+26				+116		-84	
	Z1400E	+29				+119		-81	
	390	+26				+116		-84	
	380	+28				+118		-82	
	370	+28				+118		-82	
	360	+30				+120		-80	
	350	+31				+121		-79	
	340	+32				+122		-78	
	330	+35				+125		-75	
	320	+33				+123		-77	
	310	+34				+133		-67	
	Z1300	+31				+121		-79	
	290	+28				+118		-82	
	280	+31				+121		-79	
	270	+28				+118		-82	
	260	+21				+111		-89	
	250	+22		NOT CALCULATED		+ ~~10~~ 112		-88	
	240	+8				+98		-102	
	230	-8				+82		-118	
	220	-17				+73		-127	
	210	-96				-6		-206	anomaly?
	Z1200	-70				+20		-180	
	190	+10				+100		-100	
	180	+38				+128		-72	
	170	+53				+143		-57	
18300N	Z1160E	+70				+160		-40	
18300N	Z1460E				+90		-200	-110	
	470	-2				+88		-112	
	480	-9				+81		-119	
	490	-19				+71		-129	
	Z1500	-29				+61		-139	
	510	-39				+51		-149	
	520	-54				+36		-164	
	530	-72				+18		-182	
	540	-95				~~+~~ -5		-205	
	550	-108				-18		-218	weak anomaly?
	560	-91				-1		-201	
	570	-94				-4		-204	
	580	-106	+0.5		+90	-16	-200	-216	

Additional comments: L-18300N east side continued on next page

SELF POTENTIAL DATA

PROJECT: Tommy Jack

COMMENTS: Continue L18300N Z1590E ⇒ Z1640E, Detail 18300N Z1600E ⇒ Z1620E
START L-18200N Z1480E = 6+75 S on S.P. Baseline BS Value +2, Pot Corr 0.5 mV

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
L-18300N	Z1590E	-126	-0.5		+90	-36	-200	-164	
	600	-159	↑		↑	-69	↑	~~-1~~ -131	
	610	-287				-197		-397	anomaly graphite?
	620	-145				-55		-255	
	630	-102	↓		↓	-12	↓	-212	
	Z1640E	-77	-0.5		+90	+13	-200	-87	
Detail Readings									
18300N	Z1600E	-161	-0.5		+90	-71	-200	-271	
	602	-176			↑	-86	↑	-286	
	604	-190	↑			-100		-300	
	606	-212				-122		-322	
	608	-245				-155		-355	
	610	-287				-197		-397	graphite?
	612	-270				-180		-380	
	614	-218				-128		-328	
	616	-192				-102		-302	
	618	-180	↓		↓	-90	↓	-290	
	Z1620	-145	-0.5		+90	-55	-200	-255	
L-18200N	Z1480E	—	+0.5 mV		+86	+86	-200	-114	
	470	+12	↑		↑	+98	↑	-102	
	460	+14				+100		-100	
	450	+12				+98		-102	
	440	+3				+89		-111	anomaly?
	430	+9				+95		-105	
	420	+21				+107		-93	
	410	+23				+109		~~-8~~ -91	
	Z1400E	+23				+109		-91	
	390	+24				+110		-90	
	380	+21				+107		-93	
	370	+18				+104		-96	
	360	+27				+113		-87	
	350	+26				+112		-88	
	340	+29				+115		-85	
	330	+22				+108		-92	
	320	+12				+98		-102	
	310	+20				+106		-94	
	Z1300E	+10				+96		-104	anomaly?
	290	+28				+114		-86	
	280	+32				+118		-82	
	270	+22				+108		-92	
	260	+15				+101		-99	
	250	+50				+136		-64	
	240	+83				+169		-31	
	230	+100				+186		-14	
	220	+118				+204		+4	
	210	+124	↓		↓	+210	↓	+10	
18200N	Z1200	+121	+0.5		+86	+207	-200	+7	

SELF POTENTIAL DATA

PROJECT: Tammy Jack '99

Page 18

COMMENTS: A. Series of Lines Run @ 337°, 350°, 322° From 18200N · 21260E to test ~~Res~~ Response in Soil Geochem Area, approx 10 m spacing.

Line	Station 18200N	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
BRG 337°	21260E		0.5		+101	+101	-200	-99	
	0+10	-10				+91		-109	
	20	+5				+106		-94	
	30	+39				+140		-60	
	40	-9				+92		-108	
	50	-40				+61		-139	
	60	-68				+33		-167	
	70	-79				+22		-178	
	80	-109				-8		-208	
	90	-122				-21		-221	
	100	-116				-15		-215	Same site as 183N 21210E
	110	-67				+34		-166	
	120	-62				+39		-161	
	130	-75				+26		-174	
	140m	-60	0.5		+101	+41		-159	
BRG 350°	10 m	+8				+108		-91	
	20	+20				+121		-79	
	30	+27				+128		-72	
	40	+20				+121		-79	
	50	+14				+115		-85	
	60	+3				+104		-96	
	70	-3				+98		-102	
	80	-2				+99		-101	
	90	-21				+80		-120	
	100	-11				+90		-110	183N 21240E
	110	-4				+97		-103	
	120	-12				+89		-111	
	130m	-10	-0.5		+101	+91		-109	
BRG 322°	10	+6				+107		-93	
	20	+39				+140		-60	
	30	+102				+203		+3	
	40	+114				+215		+15	
	50	+108				+209		+9	
	60	+63				+164		-36	
	70	+66				+167		-33	
	80	+78				+179		-21	
	90	+57				+158		-42	
	100	+62				+163		-37	
	110	+50				+151		-49	
	120	+34				+135		-65	183N 21178E
	130	+13				+114		-86	
	140	+41				+142		-58	
	150	+67	0.5		+101	+168	-200	-32	

Additional comments:

SELF POTENTIAL DATA

PROJECT: Tommy/Jack

COMMENTS: EAST SIDE OF UNNAMED CREEK TO CHECK GEOCHEM ANOMALY
NEW GRID B.S. VALUE = NOMINAL ∅ USED -200 NORMALIZER

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
18200N	22940E	∅	+1		∅	+1	-200	-199	
	50	-4	↑		↑	-3	↑	-203	
	60	-8				-7		-207	
	70	-5				-4		-204	
	80	-7				-6		-206	
	90	-14				-13		-213	
	23000E	-10				~~-10~~ -9		-209	
	010	-9				-8		-208	
	020	-8				-7		-207	
	030	-13				-12		-212	
	040	-37				-36		-236	
	050	-37				-36		-236	
	060	-46				-45		-245	
	070	-48				-47		-247	anomaly?
	080	-47				-46		-246	
	090	-30				~~-30~~ -29		-229	
	23100E	-39				-38		-238	
	110	-66				-65		-265	
	120	-98				-97		-297	
	130	-112				-111		-311	anomaly
	140	-104				-103		-303	
	150	-104				-103		-303	
	160	-95				-94		-294	
	170	-77				-76		-276	
	180	-84				-83		-283	
	190	-87				-86		-286	
	23200E	-92				-91	↓	-291	
	210	-105	↓		↓	-104		-304	
18200N	23220E	-108	+1		∅	-107	-200	-307	end of wire
Detail									
18200N	23120E	-99	+1		∅	-98	-200	-298	
	22	-106	↑		↑	-105	↑	-305	
	24	-115				-114		-314	
	26	-109				-108		-308	very consistent
	28	-106				-105		-305	probably
	23130	-110				-109		-309	no graphite.
	32	-112				-111		-311	
	34	-109				-108		-308	
	36	-109				-108	↓	-308	
	38	-101	↓		↓	-100		-300	
	23140E	-103	+1		∅	-102	-200	-302	
18225N	22940E	-4			∅	-4	↑	-204	survey to establish
18250N	↑	-8			∅	(-8)	↓	-208	base line values
18175N	↓	+4			∅	+4		-196	for two parallel lines
18150N	22940E	-4			∅	(-4)	-200	-204	@ 18250N, 18150N

Additional comments:
The only reason I used -200 normalizer number was to relate to grid to the west. This may not be wise!! There maybe no graphite in this area.

SELF POTENTIAL DATA

PROJECT: Tammy Jack

COMMENTS: EAST SIDE UNNAMED CREEK

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
18150N	22940E		+0.5		-4	-4	-200	-204	
	950	-21				-25		-225	
	960	-23				-27		-227	
	970	-9				-13		-213	
	980	0				-4		-204	
	990	-6				-10		-210	
	23000E	-14				-18		-218	
	010	-9				-13		-213	
	020	-5				-9		-209	
	030	-16				-20		-220	
	040	-13				-17		-217	
	050	-30				-34		-234	
	060	-54				-58		-258	
	070	-64				-68		-268	
	080	-83				-87		-287	
	090	-96				-100		-300	
	23100E	-107				-111		-311	
	110	-130				-134		-334	
	120	-133				-137		-337	anomaly
	130	-120				-124		-324	
	140	-115				-119		-319	
	150	-106				-110		-310	
	160	-93				-97		-297	
	170	-87				-91		-291	
	180	-88				-92		-292	
	190	-82				-86		-286	
	23200E	-83	+0.5		-4	-87	-200	-287	
	Detail								
18150N	23110E	-130	+0.5		-4	-134	-200	-334	
	12	-132				-136		-336	
	14	-136				-140		-340	
	16	-134				-138		-338	
	18	-127				-131		-331	
	120	-132				-136		-336	
	22	-135				-139		-339	
	24	-135				-139		-339	
	26	-129				-133		-333	
	28	-120				-124		-324	
	23130E	-120	+0.5		-4	-124	-200	-324	

Additional comments:

SELF POTENTIAL DATA

PROJECT: Tammy Jack '99

COMMENTS: EAST SIDE UNNAMED CREEK

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
18250N	22940E		+0.5		-8	-8	-200	-208	
	950	-21	↑		↑	-29	↑	-229	
	960	-34				-42		-242	
	970	-51				-59		-259	
	980	-46				-54		-254	
	990	-21				-29		-229	
	23000E	-19				-27		-227	
	010	-29				-37		-237	
	020	-34				-42		-242	
	030	-23				-31		-231	
	040	-36				-44		-244	
	050	-22				-30		-230	
	060	-49				-57		-257	
	070	-59				-67		-267	anomaly?
	080	-32				-40		-240	
	090	-43				-51		-251	
	23100E	-48				-56		-256	
	110	-56				-64		-264	
	120	-56				-64		-264	
	130	~~-47~~ -56				-64		-264	
	140	~~-47~~ -47				-55		-255	
	150	-65				-73		-273	
	160	-64				-72		-272	
	170	-78				-86		-286	anomaly?
	180	-73				-81		-281	
	190	-58	↓		↓	-66	↓	-266	
	23200E	-67	+0.5		-8	-75	-200	-275	

No Detail Readings

Additional comments: possible/probable? fault zone area covering the centre area of line

APPENDIX 3
ONTARIO GEOLOGICAL SOCIETY MISCELLANEOUS PAPER 99
A GUIDE TO PROSPECTING BY THE SELF POTENTIAL METHOD
S.V. BURR 1982

Ontario Geological Survey
Miscellaneous Paper 99

A Guide to Prospecting by the Self-Potential Method

by
S.V. Burr

1982

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Burr, S.V.
1982: A Guide to Prospecting by the Self-Potential Method; Ontario Geological Survey, Miscellaneous Paper 99, 15p.

1000-100-82-Maple Leaf

FOREWORD

A GUIDE TO PROSPECTING BY THE SELF-POTENTIAL METHOD

This guide to the self-potential method of geophysical prospecting represents part of continuing efforts by the Ontario Geological Survey to assist explorationists, and to support the development and implementation of sound mineral exploration technologies suited to Ontario conditions.

The self-potential method is small-scaled, versatile, and provides a simple, reliable and economical means of near-surface electrical prospecting for certain base metal sulphides and other mineral resources. In Canada, discoveries of important sulphide ore bodies by the SP method attest to its proven exploration value. Additionally, through research and development of the method, there should be further possible refinements and applications for SP.

E.G. Pye
Director
Ontario Geological Survey

CONTENTS

TABLES

FIGURES

Conversion Factors for Measurements in Ontario Geological Survey Publications

If the reader wishes to convert imperial units to SI (metric) units or SI units to imperial units the following multipliers should be used:

CONVERSION FROM SI TO IMPERIAL			CONVERSION FROM IMPERIAL TO SI		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
			LENGTH		
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709 7	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
			AREA		
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
			VOLUME		
1 cm^3	0.061 02	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.308 0	cubic yards	1 cubic yard	0.764 555	m^3
			CAPACITY		
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
			MASS		
1 g	0.035 273 96	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 75	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 62	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	**907.184 74**	kg
1 t	1.102 311	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 908 8**	t
			CONCENTRATION		
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

1 ounce (troy)/ton (short)	20.0	pennyweights/ton (short)
1 pennyweight/ton (short)	0.05	ounce (troy)/ton (short)

NOTE—Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries published by The Mining Association of Canada in cooperation with the Coal Association of Canada.

A Guide to Prospecting by the Self-Potential Method

by
S.V. Burr[1]

INTRODUCTION

The author has used the self-potential or spontaneous polarization (SP) prospecting method extensively for 35 years in surveying mining claims, and considers it the best of the electrical geophysical methods.

Recently, interest in the method has revived, probably due to renewed gold exploration. Most gold deposits are not good conductors, but do contain some sulphides which can be detected by the SP method.

The few available textbooks which mention the SP method are brief in their descriptions of field prospecting methods, and some prospectors, who have tried the method with insufficient understanding of the technique, have become discouraged and added to the misconceptions about it. Good practical descriptions of the SP method are contained in "Prospecting in Canada" by Lang (1970) and in "Mining Geophysics, Second Edition" by Parasnis (1975).

This guide incorporates and updates information from a previous paper by the author (Burr 1960) and is intended to instruct the layperson in the routine prospecting use of the method and to encourage more geophysical research of the SP phenomenon. Much of the material presented is unavailable elsewhere and was derived by experience through field applications.

IMPORTANT FACTS

Although the author has endeavoured to dispell some misconceptions, and to add some new facts on the SP method in the body of this guide, some isolated facts could be emphasized at the beginning:

1) Hydro and telephone lines, which plague some of the other electrical methods, do not affect SP

2) Iron formation, which acts as a "good conductor" with some of the other electrical methods, does not affect SP unless sulphides or graphite are associated with it. One major iron formation at the Sherman Iron Mine, Temagami, Ontario, contains graphite. The SP method begins to detect this anomaly at least two miles away. On the basis of one long north-south traverse conducted by the author, a peak of 4000 mv (4 volts) was obtained over or near this iron formation.

3) Buried or grounded metal objects can produce spurious SP "spot anomalies". A buried long metal pipe can produce a linear and sometimes genuine-looking (pseudo)anomaly. Graphite cathodes are used beside gas pipe lines to prevent corrosion and can produce an abnormally high negative SP anomaly. Similarly, it can be demonstrated that an axe, pick or knife driven into the ground beside the forward pot (an SP ground electrode) produces a high negative reading in the instrument.

4) Several years ago in Northern Quebec, the author discovered a graphite SP anomaly of 1 volt at a pot separation of 300 feet. An unsuccessful experiment was conducted to try and achieve a 6 volt potential and power a radio. An additional pot merely cut the potential to .05 volts. Apparently the current strength or "ground amperage" in a near-surface self-potential electrical field is not proportional to the number of pots used.

5) Natural SP anomalies of a few hundred to over a thousand millivolts, and of negative sign by convention, are caused by the iron sulphides pyrite and pyrrhotite, the copper sulphide chalcopyrite, and the native element graphite. Graphite gives the strongest SP reaction, followed by pyrrhotite, pyrite, and chalcopyrite. Strong negative anomalies have also been reported over chalcocite, covellite and anthracite (Sato and Mooney 1960). Because of the many other factors influencing the strength of an SP response, it is not possible to predict which type of sulphide is responsible for the anomaly. A magnetometer or dip needle survey may help to determine whether the magnetic

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iron sulphide pyrrhotite is present or not.

6) Magnetic storms, dealt with in the "Instructions" section of this guide, are a natural phenomenon which can be detected by the SP instrument. It has been suggested that approaching earthquakes, or an atomic explosion anywhere in the world could be detected by a monitoring SP instrument. In California, the method is used to locate water leaks in pipelines; in Australia, to detect salt springs; and it can also be used in geothermal exploration and in structural studies. Other applications are also possible but await further research of the SP method.

7) Manganese oxides (psilomelane and pyrolusite wads) have been observed to give positive SP anomalies. In Jamaica, the author detected high grade manganese "veins" or "dykes" which gave strong positive anomalies. The sedimentary Sibley Formation in the District of Thunder Bay, Ontario contains a manganese oxide unit which produces alternating high positive and high negative readings which the author interprets as a possible indication of the presence of graphite.

8) Finally, the peak of an SP anomaly is detected with the measuring pot positioned directly above the source. This is in contrast to other electrical methods which can be responsive to the dip of the anomalous source, and through misinterpretation have led to some drill holes that have overshot, or have been spotted too far from or too near the target.

BRIEF HISTORY

The SP method is the earliest electrical geophysical method to be discovered or invented. It was first applied in England by Robert Fox (1830) who conducted SP research around the tin mines of Cornwall, and later by Carl Barus (1882) who applied the method at the Comestock Lode in Nevada. The first sulphide orebody discovered by an electrical method was detected by SP at Nautenen, Lapland, Sweden in 1907 (Lundberg 1948).

BRIEF THEORY

Most explanations of the SP phenomenon propose that a "wet" sulphide (or graphite) body develops negative and positive electrical potentials at its top and bottom, resulting in a both metallically and electrolytically mediated "flow" of electrochemically generated current around and through the body as shown in Figure 1.

It is possible that sulphide and graphite bodies in contact with ground water electrolytes induce a "spontaneous" DC flow of current, but local ground currents are not solely related to potential differences arising from spontaneous polarization of a conducting body. The author considers that the natural telluric fields and currents encircling the earth provide a natural applied electrical

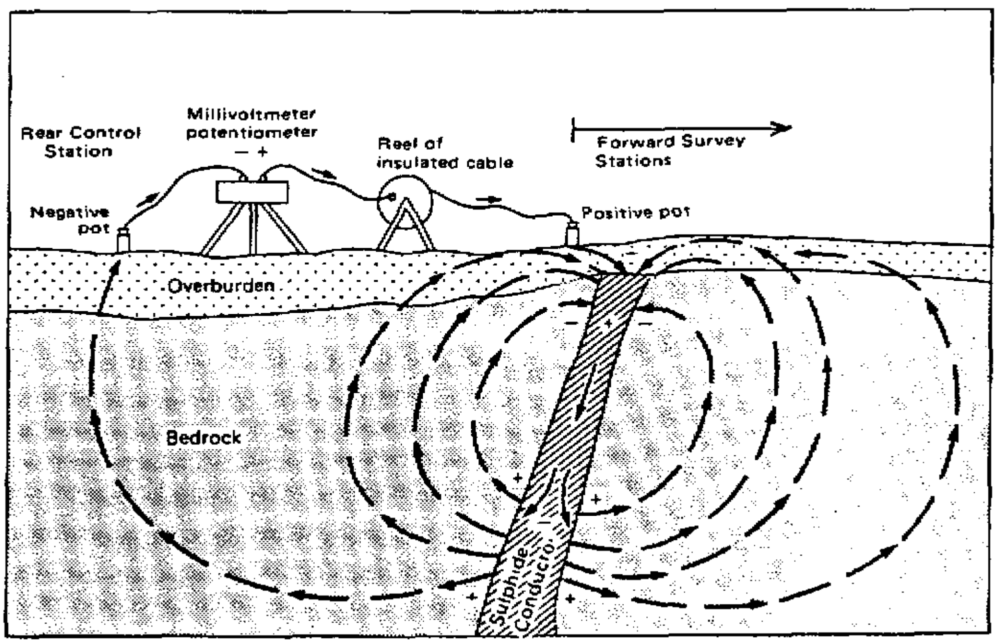

Figure 1—Schematic representation of spontaneously generated electric current flow near a sulphide body, showing current paths through the ground and the SP apparatus (after Lang 1970).

field which—close to an electrolyte-bathed SP body—can give rise to a "conductive" spontaneous polarization effect which distorts the local primary geosymmetry of natural electrical fields near the earth's surface.

For example, if these ground currents are flowing through an electrically isotropic and homogeneous rock type, they are like the parallel, equispaced strings of a harp, and a uniform potential difference field is developed (see A in Figure 2). If they are passing through different rock types with different conductivities, some of the nearby "harp strings" will converge slightly to take advantage of a better conducting rock unit, resulting in a "resistivity" map which differentiates between different conductivities of the rock types (see B in Figure 2). If the currents come upon sulphides or graphite they will be drawn towards such bodies in an attempt to flow through them, resulting in a high potential or anomaly (see C in Figure 2). Finally, in a strong magnetic storm, the harp strings will quiver as if they were being stroked (see D in Figure 2). The effect of a magnetic storm will be discussed at greater length in the "Instructions" section.

COMPARISON OF ELECTRICAL GEOPHYSICAL METHODS

Although the SP method was extensively and routinely used during the 1930's and 40's by many well-known professional geophysicists, currently, it is generally misunderstood or overlooked as a useful and economical geophysical prospecting method.

The first orebody found in Canada by electrical methods was surveyed by Hans Lundberg (1928) at the Buchan's Mine in Newfoundland, where conductive ore was detected using the SP method. At least one orebody was found in the Noranda area and Lundberg (1948, p.179) reports: "...a lead-zinc-copper orebody was found in the Eastern Townships of Quebec. This survey was carried out by A.R. Clark and H.G. Honeyman, and the results were well confirmed by subsequent drilling." He also states: "The outlining of the Flin Flon orebody in Manitoba is perhaps the best known example of his [Sherwin Kelly's] surveys."

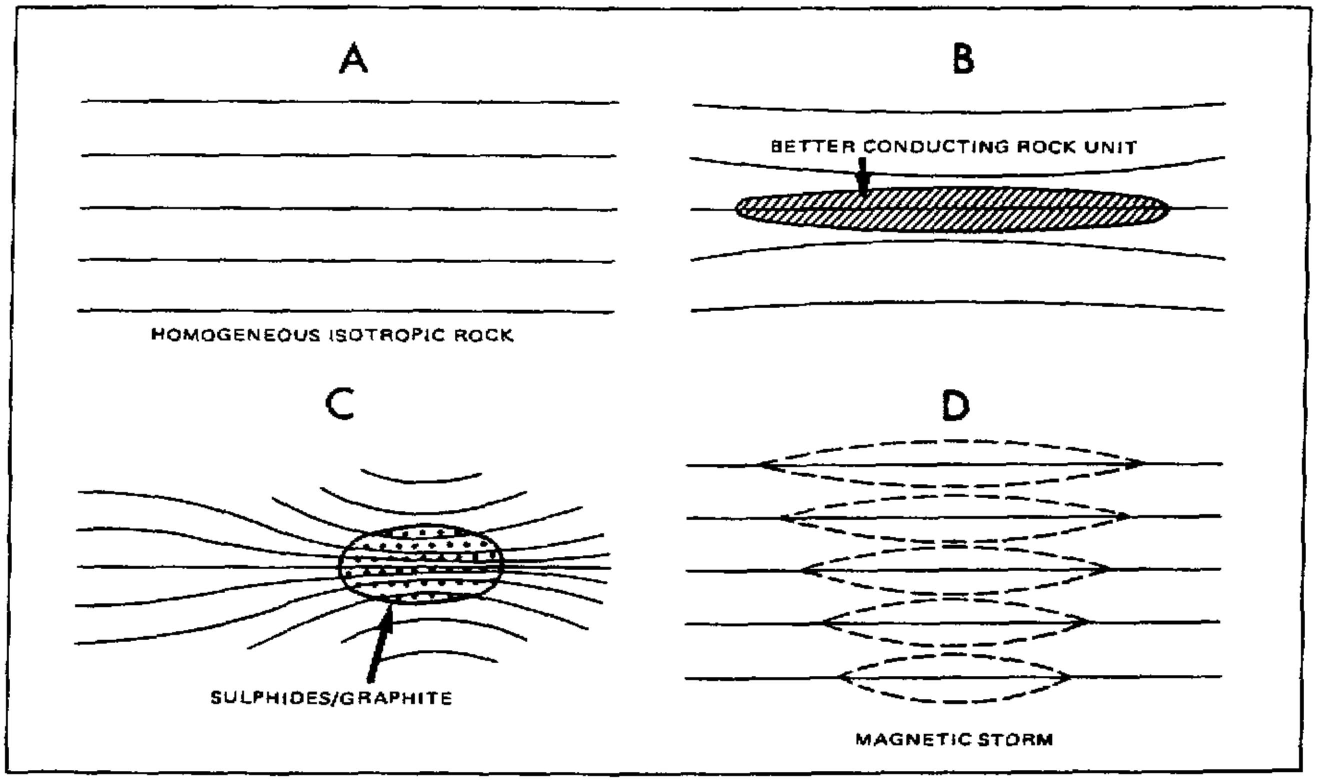

Figure 2—Schematic representation of various naturally occurring configurations of electrical equipotential fields.

The author was involved in early field surveying experiments with the resistivity method, using formulae developed by Dr. Arthur Brant, University of Toronto. This method requires the "pushing" of alternating current into the ground and can provide an excellent interpretive model of the geological stratigraphy and structure. Resistivity surveying can also detect conducting anomalies which may correlate with buried sulphides or graphite. However, the method was found to be cumbersome and slow, and soon gave way to the faster, more portable, but less informative electromagnetic (EM) methods. More recently the induced polarization (IP) method has been developed and applied. It also "pushes" current [as DC pulses which naturally decay] into the ground but is much more cumbersome than the resistivity method, and much more expensive than most of the EM methods. It is considered to be a composite of the resistivity and SP methods and is capable of detecting low resistivity "good" conductors and disseminated sulphides (including oxidized orebodies).

Unfortunately, the interpretation procedure is complicated and the method will equally well detect iron oxides and other semimetallic uneconomic minerals. A drawback with the resistivity, EM and IP methods is that they measure secondary electrical fields which are sometimes difficult to interpret. They also respond to unmineralized wet shears, faults, and fissure zones. Perhaps the most common cause of "false" anomalies with these methods is the variable depth of overburden over the rock surface. If there is a subsurface valley buried by overburden, all the above methods will yield a "psuedoanomaly" similar to an anomaly observable over a massive sulphide zone.

Alternatively, the SP method does not determine secondary fields, so survey results are much easier to interpret. It does not respond to subsurface valleys, wet clay, shears, or faults; and, in the author's experience, the SP method does not provide results which could lead to a false anomaly. In over 500 SP anomalies which were stripped or drilled, the author always found the source of the SP anomaly to be sulphides and/or graphite in the underlying rock.

The SP method responds to good conducting sulphides (both oxidized and unoxidized bodies), graphite, and nonconducting (disseminated) sulphides if these sulphides are oxidizing. The author has encountered only two cases where disseminated sulphides were not detected by the SP method. In one case, an exposure of disseminated pyrite showed no oxidation "rust" (gossan) whatsoever; in another, sulphides of a pyrite-chalcopyrite-bearing copper orebody were also fresh, and the pH of the ground water was found to be 10.0, too basic to oxidize the pyrite. According to Lundberg (1948, p.179): "The self-potential method must be used with some caution....and many orebodies may not cause any anomalies at all, owing to certain ground-water or overburden conditions." The proportion of nonoxidizing, nonconducting sulphide bodies is unknown, but the author expects that the number in Canada is probably very small. It is this small percentage of nonconducting sulphide bodies which prevents one from saying the SP is a "Yes" or "No" method in geophysical prospecting for sulphide ores. It is a Yes or No method for the detection of good conductors only, but not necessarily for disseminated sulphides.

Another feature of the SP method is its ability to differentiate between anomalies caused by sulphides and anomalies caused by graphite. Sulphides produce a range of up to 350 millivolts between the most positive and most negative SP readings, graphite has a higher range. The SP method also has the ability to "smell" an anomaly some distance away and can smell graphite at a greater distance than sulphides.

One of the popular misconceptions about the SP method is that it is limited to shallow depths as its detecting ability is dependent on the presence of oxidizing sulphides which usually occur close to surface of the earth. Lundberg (1948, p.179) states: "The self-potential method is based on the fact that slowly proceeding weathering in the upper portion of a sulphide body is accompanied by electrical potential differences between the surficial oxidiation zone and the deeper nonoxidized portions of the orebody". Lang (1970, p.162) contends this idea by noting that graphite is not oxidizing. The author has located disseminated sulphides under 25 m of sand (including a quicksand layer), and a weak conductor under 36 m of overburden. Lang (1970, p.162) also states: "...reactions at the surface may become too weak to interpret when the overburden is more than about 300 feet [91 m] thick." The author has located "heavy" sulphides capped by 7.6 m of barren rock, with no apparent indications of oxidation.

Another misconception is that one can derive a formula to determine the percentage of sulphides in an SP anomaly based on the strength of the readings. Lang (1970, p.162) states: "The strength of the potential generated depends largely on the concentration of sulphides." One cannot, however, determine any variations in the strength of anomalies as dependent on the concentration of sulphides. For example, the strongest SP value along the strike of an anomaly does not occur where the sulphides are most highly concentrated, but where the source of the anomaly is closest to surface. With a little practice, one can determine whether the source of the anomaly is close enough to the surface to be exposed by stripping. Details are given in the section "Mineral Prospecting with the SP Method".

Although the author has stated that the SP method does not give false anomalies, certain operator errors can produce them. To help operators avoid such errors is one of the objectives of this guide.

LIMITATIONS OF THE SELF-POTENTIAL METHOD

As no one geophysical method is all-embracing, the following limitations of the SP method should be borne in mind when planning surveys:

1) The SP method cannot be used over water. How

ever, Lang (1970, p.162) states: "Where sulphide deposits lie beneath lake waters, the method is not usually applicable *except over the ice in the winter*". Further research is needed to refine this technique.

2) Winter surveys are now possible through snow cover using high impedance voltmeters, but dampness can short-circuit the instrument, extreme cold can weaken the batteries, and ice can encrust the pots and prevent ground contact. Preventive measures include addition of glycerine to the pots, and carefully planned quick checks over target areas, to maximize surveying before prolonged frigid temperatures can affect the equipment.

3) An SP anomaly does not indicate whether conducting sulphides are disseminated or massive. Accordingly, the anomaly could be tested by another electrical method such as VLF (very low frequency) to determine whether it is a good conductor. At the same time, the anomaly could be checked with a magnetometer to determine whether the magnetic iron sulphide pyrrhotite is present.

4) As mentioned in the section "Important Facts", the SP method responds to pyrrhotite, pyrite, and chalcopyrite. It does not respond to zinc, lead, gold, or silver minerals. However, some iron or copper sulphides are generally present with these other metals and, if oxidizing, will result in an SP anomaly.

5) In the case of a strong and obvious graphite SP anomaly, the method cannot indicate the presence or absence of associated sulphides. Presently, only one instrument, the RONKA EM-15, can resolve associated sulphides, but only if the anomalous source is shallow, and if any associated sulphides are good conductors. For reasons not fully understood, this instrument only responds to good conducting sulphides, but not to graphite.

SELF-POTENTIAL EQUIPMENT

A millivoltmeter-potentiometer is used to take SP readings by a needle and scale, digital readout, or an adjustable dial which brings a needle or audio signal to a null position. The operator will likely make fewer mistakes in recording with a digital readout. Readings should be double-checked for precision, particularly at established control stations.

A basic requirement is a reel of wire. In most cases, more than 600 m of wire is desirable. Another useful and timesaving item in conjunction with the use of a long wire is a pair of walkie-talkies. Lastly, the most important items are the porous pots. If these do not function properly, the survey becomes a wasted endeavour. Occasionally the millivoltmeter may get wet and short-circuited. This condition is easy to detect if not to rectify. Also, the wire may develop a bare spot which may make contact with the wet ground and give a sudden strong negative reading. This is also easily identified, though of infrequent occurrence. In some circumstances, an unmonitored pot may change its potential along a survey line and produce false anomalous readings. The pots are crucial to the successful operation of the SP equipment, and accordingly, will be discussed first in the "Instructions" section.

INSTRUCTIONS

(1) Operation of SP Equipment

The Pots

The two pots are generally made of porcelain ceramic in hollow cylindrical forms with porous bottoms. From the caps, copper electrodes are suspended down into the pots. A saturated copper sulphate solution is used as the medium to connect the porous pot contact with the ground, which establishes a mediated electrical contact with the copper electrodes suspended in solution. If two bare metal electrodes made contact with the ground, there would be an instantaneous surge in polarization between them which would then drop quickly to zero. With the copper sulphate solution as the mediator of the ground contact, no net polarization effect involving a discharge of current takes place and the relative potential difference between two survey stations can be measured with considerable accuracy.

Occasionally, the two pots will have, or may develop an inherent potential difference between them. If this is only a few millivolts, no harm is done in running survey lines with the reel and not correcting the individual readings. An error of a few millivolts will not result in false or obscured anomalies. However, a high pot potential difference can be very critical in some situations as discussed below.

The reason for an original pot difference is probably due to slight variations in construction making one pot more porous than the other, and thereby, of a slightly different conductive response. This is usually a fixed and unchanging condition which does not hamper the SP survey. However, a sudden change in pot difference may be caused by a crack, by contact of the porous part of the pot with metal or sulphides, by the drying out of one pot, or by the solution in one or both pots becoming undersaturated in copper sulphate. The pot difference should be checked often; for example, at the start of the day, at noon, at the end of the day, and at each control station and tie-in point.

The filling of the pots must be carried out with care, the level of the solution checked often, and additional crystals or powder added frequently as required. Without ample copper sulphate solids in contact with the solution, a rise in temperature of one or both pots may result in undersaturation. This is because of the increased solubility of copper sulphate at higher temperatures. To make the saturated copper sulphate solution, it is advisable to heat the water as the crystals are being added, until the solutron is hot and solid crystals are still present. A pyrex bowl is recommended, as the solution is corrosive, and a wooden spoon or stick is useful for stirring.

Jellying the Pots

If the pots are to be used for a week or more, it is timesaving to make a jelly of the solution. Only enough jellied solution to fill the two pots is required. The operation is similar to making any jelly, except it is advisable to add two or three times as much gelatin to the water to make a good set. The hot water plus gelatin solution should be well stirred as the copper sulphate crystals are added. After the solution has cooled, a few crystals should be added to each pot. The jelly solution can then be poured into the pots, capped, and allowed to set. One set of jellied pots should last an entire prospecting season of 3 or 4 months.

However, the pots should always be stored under moist conditions away from excessive heat to prevent evaporation and danger of drying out.

Pot Difference

Once the pots have been filled and allowed to cool it is possible to determine by a simple procedure whether there is any inherent pot difference:

(1) The pots are placed on or in the ground, close together, with one pot connected to wire running from the positive ("far") connection of the millivoltmeter, and the other pot connected by wire to the negative ("near") connection. A first reading is taken.

(2) The pots are now reversed leaving the same wires attached to the positive and negative connections of the millivoltmeter, and a second reading is taken.

(3) The formula for calculating the pot difference is: (1st Reading + 2nd Reading)/2.

For example, if the *1st Reading* is -8 millivolts and the *2nd Reading* is +10 millivolts, the pot difference is ((-8) + (+10))/2 = +1 mv. These relatively high readings indicate that the potential difference between the ground and each pot is 9 millivolts, suggesting that the pot difference was measured in an anomalous area. However, as long as the correct procedure is followed, the true pot difference is obtainable anywhere. Once the magnitude of the pot difference is established, the positive and negative pots should not be interchanged during the course of SP survey readings. An alligator clamp on the "forward" positive pot is ample identification, and is useful for engaging and disengaging the end of the wire. The pot difference should be regularly monitored and carefully measured at each control station and tie-in point.

The Millivoltmeter-Potentiometer

Most voltmeters are accompanied by full operating instructions which describe how to read the instrument. It is important to emphasize that by convention the *forward* advancing pot should be linked to the positive or *far* instrument connection and the stationary or *rear* control station pot should linked to the negative *near* connection (Figure 1). With the positive pot moving "ahead", anomalies are negative after the traditional Carl Barus method which is the currently accepted convention. If the negative pot is inadvertently sent ahead, strong positive readings would be anomalous.

The Reel of Wire

Wire used in SP prospecting should be strong, thin, light, flexible, and well-insulated with a smooth surface. Depending on the roughness of the terrain, thickness of underbush, and straightness of the traverse line, a 0.8 km length of wire can be pulled off a reel to its end. Wire should be attached to the forward pot by a clove hitch knot, with a bared end connected to the copper electrode which protrudes above the pot cap. The connection should be made with a short piece of insulated wire securely attached at one end to the pot electrode, and to an alligator clamp at the other end in order to make contact with the reel wire. With this arrangement, an SP surveyor can pull the wire and the forward pot with one hand without danger of disengagement of the pot connection.

Theoretically, the potential difference due to the SP effect could be measured with the two pots several kilometers apart. Although impracticable, a longer wire is preferable as more readings can be taken with the millivoltmeter and rear pot set up at a single control station, and fewer control stations are needed as discussed below.

A reel with only 244 m (800 ft) of wire should not be spliced onto an extra length of wire. Regardless of how well the wire is spliced and insulated, it will come apart or become entangled under most field conditions. The time gained from avoiding such survey delays will more than compensate for the cost of an appropriate length (e.g. 610 m (2000 ft.) of wire.

The positive wire from the millivoltmeter should have an alligator clamp to attach to the reel wire, as it is generally necessary to disengage the clamp before the reel unwinds.

The Walkie-Talkies

Although the two SP operators can shout for a few hundred meters and then send messages by tugs on the taut wire, a faster and more reliable survey can result from use of walkie-talkies for voice communication. The forward operator can describe the topography (e.g. swamps, creeks, up-hill, down-hill, etc.) to the note-taker operating the millivoltmeter, and can notify when the forward pot is in ground contact and ready for a reading. Often, the reel will stop, the instrument operator will attach the millivoltmeter at the rear control station wire, and then the reel will suddenly move forward, resulting in possible damage. The instrument operator can also inform the forward operator of the trend of the readings, and, if "smelling" an anomaly, to cut down the readings from, for example, 20 m intervals to 10 m or less for a preliminary detailed survey of the anomaly.

The walkie-talkies should not be so powerful as to interfere with nearby citizens bands.

(2) Conducting an SP Survey

After the pots have been prepared and the initial pot difference measured, they may be combined with the millivoltmeter, the reel of wire, the walkie-talkies, and weatherproof note-taking materials in preparation for an SP survey along a predetermined line grid. The starting procedure will depend on the size of the grid and the length of wire on the reel. For example, the grid shown in Figure 3 is oriented with a base line (BL) parallel to the structure or strike of rock units and cross lines at right angles.

With 610 m (2000 ft) of wire a survey moving from east to west could effectively cover the area as follows: (1) The first control station is established on the base line at cross line 4W. This station is given a *tentative value* of 0 mv. (2) The pot difference is recorded, and (3) SP survey measurements are recorded along with pot locations and other notes, north and south on lines 0, 4W and 8W, as well as readings along the base line between line 0 and line 8W. Readings should never be taken at forward pot spacing intervals of over 15 m (50 ft), except possibly along the base line. In exploration for narrow vein deposits, the intervals should be shortened to define the peak. Bends in the wire of 90 degrees or even 360-degree loops do not affect the readings.

After line 8W has been traversed, readings are taken along the base line to line 16W where a careful measurement is taken and added to the inverse of the pot difference. Next, the second control station at BL,16W is established. If the tentative value of the second control station is +5 mv, then all readings taken from the second control station set-up—along lines 12W, 16W, 20W, and

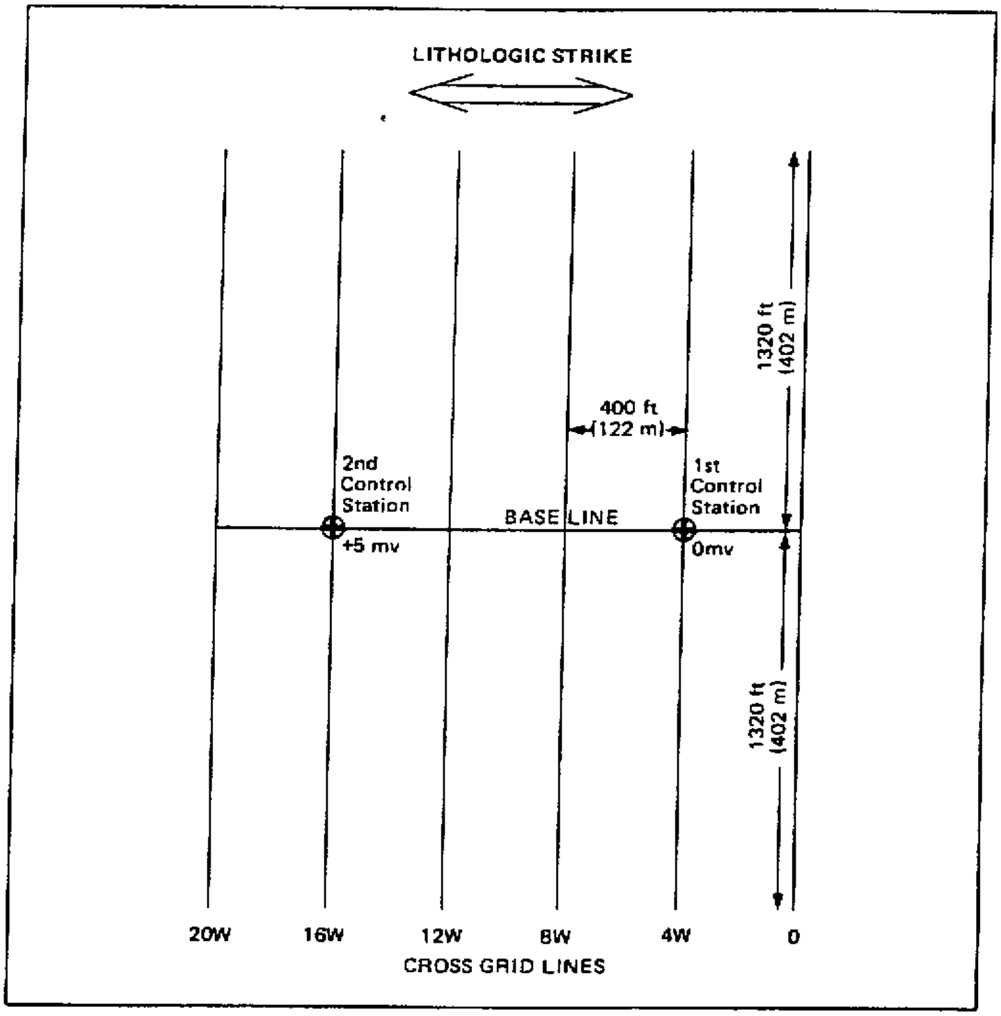

Figure 3—An example of logistical details for an SP survey conducted with 610 m (2000 ft) of wire (see also Table 1).

the rest of the base line—are relative to a value of +5 mv. For example, a reading of -25 mv gives a tentative value *for that point, or survey station, of -20 mv. All readings or* final adjusted values may be plotted on suitably scaled maps beside the appropriate survey stations.

With only 244 m (800 ft) of wire, an SP survey conducted over the same grid would require more set-ups, or control stations (Figure 4). In such a situation the first control station is set up at 7+00N on line 0 (tentative value 0 mv), and readings taken north, and south to the base line. Along the base line the pot positions should be carefully marked for tie-in with other control stations south of the base line. After the northern part of line 0 has been run, a reading is taken at 4W,7+00N and the inverse of pot difference is added. After this, the rear operator traverses over to 4W,7+00N where a second control station is established. The rest of the northern part of line 4W, including the base line, is surveyed and the procedure is repeated across the northern section of the grid to control station 20W, 7+00N. Next the pots, millivoltmeter, and reel of wire are moved to 20W,7+00S. The southern section of line 20W is traversed, tieing-in at the base line station. Assuming the value at BL,20W had been given as -23 mv from the control station at line 20W,7+00N; then, if *the reading (including pot difference) from the new control station* at 20W,7+00S is +10 mv, it follows that the new control station is 10 mv more negative than the base line at line 20W— thus -33 mv. The survey is continued eastward in the same fashion as the north section. It is unlikely that the rest of the base line tie-ins will check as the potential will have changed somewhat because of moisture and temperature variations. *Any discrepancies* should not produce or hide anomalies. Nevertheless, it is obvious from the above examples that a longer wire provides better control of background SP variations over a larger area (2 control stations versus 12 control stations and 6 tie-ins), and allows a faster and more efficient survey to be run.

When following the normal procedure of placing the pots on or in the ground, it is possible to obtain variations of up to 110 mv due to the varying acidity and bioelectric activity of soils. Wet swamps tend to give positive SP values, and dry hills negative ones. In areas where there is a more uniform type of soil cover, the background range is

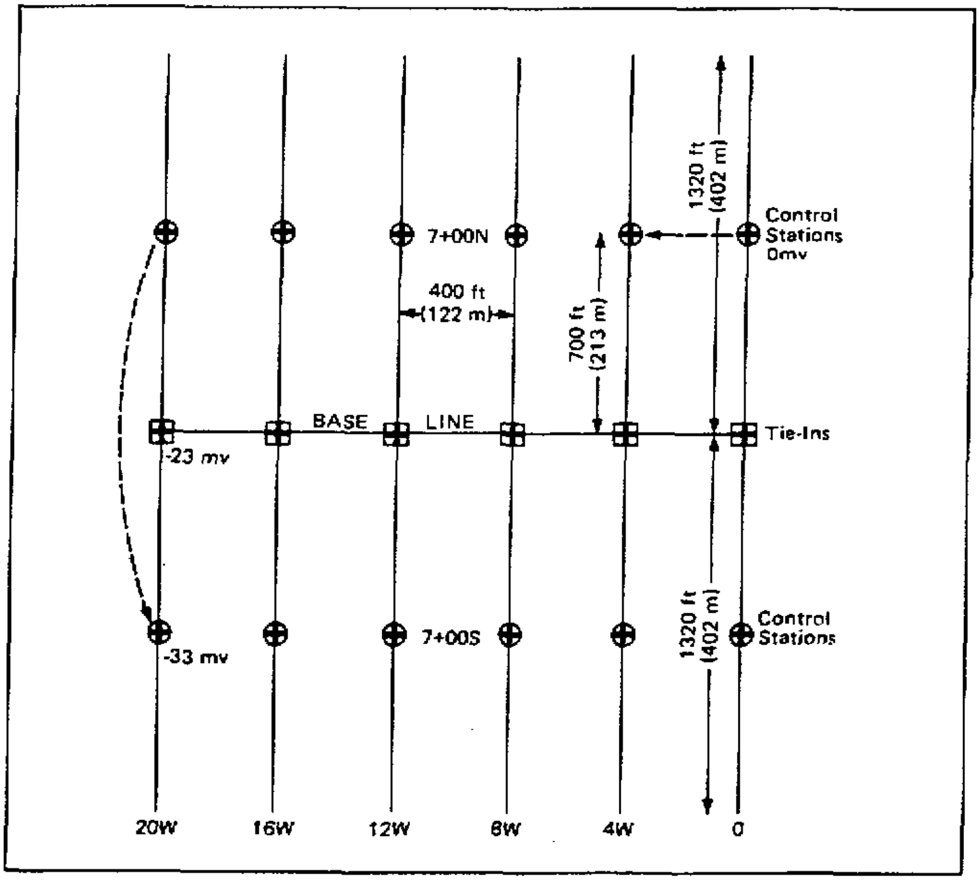

Figure 4—An example of logistical details for an SP survey conducted with 244 m (800 ft) of wire.

much less. As an extreme example of this, a detailed traverse across a 244 m (800 ft) wide tailings pond may give a range in readings from +1 to -1 mv, probably due to the uniform acidity of the tailings. The author observed similar small variations in the residual soils of Jamaica. Lang (1970, p.162) states: "Pronounced slopes...-sometimes introduce a topographic effect..." Fortunately, in Canada this potential variation of the background agrees with the topography, and, in nonanomalous areas of swamps and hills, the SP contours correlate to topographic features. This is one reason why the topography at each station should be noted. Another important reason is shown in Figure 5.

Figure 5 represents hypothetical SP values along one line. In example **A** SP measurements occur on a "flat" map showing no topography, such that the weak negatives opposite the **?** would normally be ignored. Example **B** shows a small rise which would explain the negative readings in terms of normal background topographic variation. However, if there is a swamp, as in

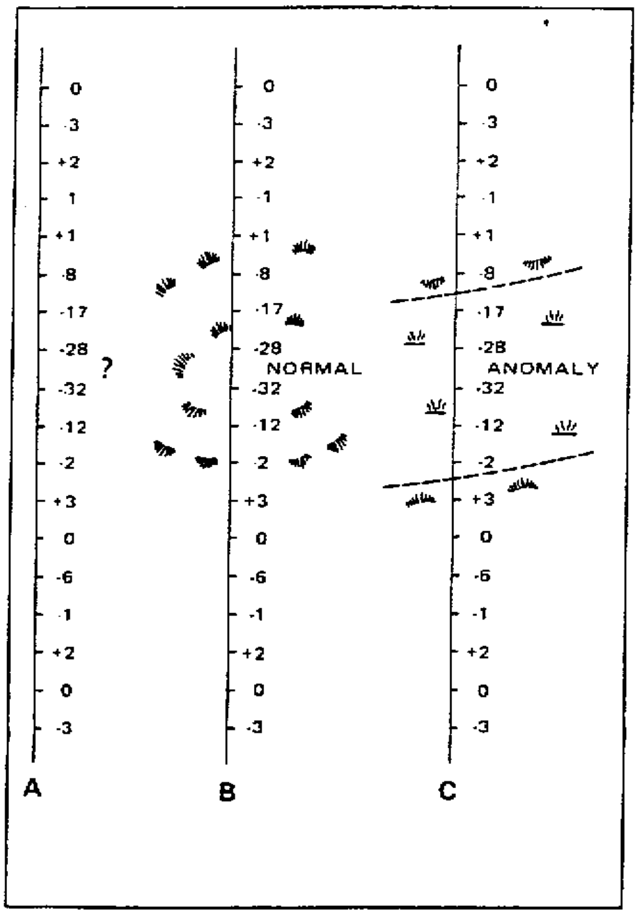

Figure 5—Theoretical SP readings showing the effects of topography.

example **C**, these weak negatives would definitely be anomalous.

Under favourable conditions an SP survey such as that depicted by Figure 3 could cover the area with a few hundred readings in one or two days, traversing approximately 4 km of grid. If an SP survey detects strong anomalous negatives and has also covered a few swampy areas, it is likely that the greatest positive and negative values of the survey have been encountered. As an example, SP survey notes might read as shown in Table 1.

If the range of values is of the order of 250-300 mv, or more, about one third of that range is probably background variation due to the varying acidity of the soils. In this case, if the most positive tentative value is near +100 mv, or near +10 mv, it should be given an adjusted value of +50 mv and the other tentative values adjusted accordingly. For example, if the most positive tentative value is +75 mv, it is adjusted to +50 mv, and it follows that a *normalizer* of -25 mv must be added to all the tentative values, as in Table 1, to yield the *final adjusted value*.

If the most positive tentative value is between +40 and +60 mv, no adjustment is necessary. In most cases the most positive value is over a swamp or low wet ground.

In some localized anomalous areas the range from most positive to most negative readings may be 150 mv, or less, and is probably due to a more uniform soil cover. In such a case, the most positive tentative value should be adjusted to about +25 mv. In most circumstances, one does not know at the time when the first control station is set-up, what anomalous conditions will occur. On more than one occasion, the author has unknowingly set-up a first control station over an anomaly and all the subsequent readings were positive to high positive.

The purpose of the adjustment is to attain a final balanced background range about the zero value, such that the anomalous signals are more readily recognized and interpreted. The background is the range of electrical self-potential which is due mostly to variations in topography or soil pH. For example, a final adjusted value of -50 mv on top of a hill would not necessarily be anomalous. A value of -70 mv, or more negative, would be. In the second case above, with a background range of 50 mv or less, an adjusted value of -25 mv on top of a hill would not necessarily be anomalous. A value of -40 mv would be. It should be stressed that over a swamp, as illustrated above, an anomaly due to buried sulphides might be much less negative, or in some cases, a low positive. SP anomalies under swamps and deep overburden are much weaker than on hills and shallow overburden. Thus, topographic information is needed in this type of electrical survey. Below, in the section on "Alternative Field Methods", a simple technique which minimizes the topographic effect is discussed.

Magnetic Storms

Solar flares produce geomagnetic disturbances which are related to the phenomenon of the aurora borealis and can cause magnetic storms of several days duration.

TABLE 1 AN EXAMPLE OF SP SURVEY NOTES FOR A SURVEY CONDUCTED WITH A REEL OF WIRE 610 METERS (2000 ft.) LONG ON A 400 ft. – SPACED GRID (see Figure 3).

Control Station	Survey Station	Reading	Tentative Value	+(-25) = (Normalizer)	Final Adjusted Value
				(Millivolts)	
BL, 4W	—	—	0		-25
	BL,3W	+3	+3		-22
	BL,2W	-8	-8		-33
	BL,1W	-12	-12		-37
	BL,O	-7	-7		-32
	O+5ON	-2	-2		-27
	:				
	etc.		(a "quiet" area)		
	:				
	BL,16W	+5	+5		-20
BL,16W	—	—	+5		-20
	BL,15W	-25	-20		-45
	:				
	etc.		(probably anomalous)		
	:				
	BL,12W	-70	-65		-90
	O+50N	-44	-39		-64

The intensity and effects of magnetic storms in northern areas are enhanced near strongly magnetic iron formation. During a magnetic storm, SP readings fluctuate in an unpredictable and random fashion similar to fluctuations observable on a magnetometer under the same conditions. Generally, the magnetic storm has no effect on the SP readings until the two pots are more than about 100 metres apart; and increased pot separations increase the violence of the fluctuations. Magnetic storms may start suddenly and last only a few minutes, or they may last a few days. Except for short traverses, an SP survey with a reel of wire is not possible under storm conditions. Below, an alternative field method will be discussed which can avoid the effects of a magnetic storm.

(3) Alternative Field Methods

Topographic Problems

Although the influence of topography on SP readings may be interpreted and anomalies recognized, the problems can be confusing to the inexperienced operator. For several years, the author has used a technique which effectively inhibits the topographic effect and gives better ground contacts, even on rubble and bare outcrops.

First, two porous canvas sample bags are filled with material which will stay wet for several hours, such as black muck, loam, or sawdust. Second, a pot is inserted in each sample bag and tied on. Both pots are then in contact with a medium of constant pH, and the influence of varying acidity is strongly attenuated. As a result, readings become more uniform, the background displays a narrower range, anomalies in swamps are better defined, and anomalies on hills are less negative and less exaggerated. A final adjusted value of +10 mv for the most positive value is adequate, and a -25 mv value may be anomalous.

Magnetic Storm Problems

A magnetic storm can hamper or preclude an SP survey conducted with a reel of wire. However, by moving both pots at a constant separation along a survey line, it is possible to overcome the effects of a magnetic storm. Only on rare occasions such as in northern latitudes near strongly magnetic iron formation, could there be any fluctuation with a pot separation of about 15 metres (50 ft) or so.

There are two alternative methods by which two operators can move aong a survey line without the reel, but linked together by about 20 m of wire, to allow for 15 metre-spaced (50 ft) readings in rugged topography. Both methods are much faster than a survey conducted with a reel since it is not necessary to walk back along a line and reel the wire in. From the base line the operators can survey along the longest lines, traverse across along a tie-line or through the bush to an adjoining line, and survey along it back to the base line, and over to the starting station to tie in—similar to magnetic surveying methods.

One method requires that the rear negative pot be moved up to the same ground contact location on which the forward positive pot was positioned. Under field survey conditions this method is impracticable due to the difficulty of placing the rear pot on the exact ground contact position of the forward pot, such that every station becomes an uncontrolled "control station".

A preferable alternative for SP surveying during magnetic storms is the "leapfrog method" shown in Figure 6.

This method solves the problem of uncontrolled control stations, but adds to the arithmetic computations of the operator taking notes since each station has to be evaluated before the next station is "read". Both of the methods involve adding the inverse pot difference to each reading

For example, the leapfrog pattern can be started from an established control station on the base line with an assigned tentative value of 0 mv. An example of typical survey notes is shown in Table 2.

The control station, with a tentative value of 0 mv, reads the positive pot at 0+50N. The reading is +5 mv; thus, with a pot difference (P.D.) of -1 mv, the corrected reading is +6 mv and the tentative value is 0+6 = +6 mv. Next, the negative pot is moved to 1+00N and reads station 0+50N. The corrected reading is -9 mv. Thus, 0+50N is 9 mv more negative than 1+00N; or 1+00N is 9 mv more positive than 0+50N. Thus 1+00N has a transposed reading of +9 mv (see Table 2), and the tentative value at 1+00N is (+6) + (+9) = +15 mv. The positive pot is then moved from 0+50N to 1+50N. Station 1+50N has a tentative value of +31 mv. The negative pot is then moved to 2+00N and reads 1+50N. If the corrected reading is +36 mv, then the transposed reading of -36 mv means that 2+00N is 36 mv more negative than 1+50N and thus has a tentative value of -5 mv.

To ensure that results are meaningful, it is important to keep a careful record of each reading and calculation for later rechecking. On returning to the base line, the readings should be tied-in to the control station from which the traverse started An exact tie-in or equivalence of starting and finishing readings at the control station is unlikely, but depending on the number of stations read, one can treat the tie-in error as one would treat corrections for magnetic diurnal variation during a magnetic survey. For example if the tie-in reading is +50 mv after 50 readings, then working backwards one would distribute the discrepancy by adding -50 to the last reading, -49 to the second last, and so on. However, if the change in readings at the control station is several hundred milli-

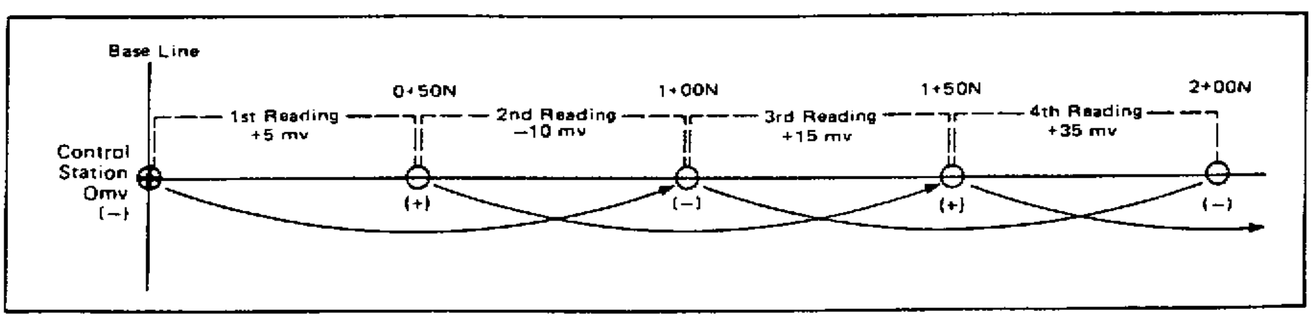

Figure 6—An example of the "leapfrog" method of SP surveying with a fixed length of wire (see also Table 2).

TABLE 2 AN EXAMPLE OF SP SURVEY NOTES FOR A SURVEY CONDUCTED USING THE "LEAPFROG" METHOD WITH A FIXED LENGTH OF WIRE (see Figure 6).

Control Station	Survey Station	Pot	Reading plus inverse Pot Difference P.D. = (−1)	Transposed Reading at Negative Pot	Tentative Value	Final Adjusted Value
				(Millivolts)		
BL,O	0+00	(-)	—	—	0	....
	0+50N	(+)	+5+(+1)=+6	+(+6)	+6	....
	1+00N	(-)	-10+(+1)=-9	-(-9)	+15	....
	1+50N	(+)	+15+(+1)=+16	+(+16)	+31	....
	2+00N	(-)	+35+(+1)=+36	-(+36)	-5	....

volts it is necessary to recheck calculations or resurvey the lines.

Although faster, this alternative method is somewhat complicated, requires careful arithmetic, and usually involves an adjustment to bring the relative values into reasonable perspective for interpretation. Despite savings in time, it is not recommended unless one is obliged to use it due to magnetic storms or a shortage of wire.

(4) Notes on the Interpretation of SP Survey Results

The results of an SP survey can be effectively represented and interpreted by using maps on which the final adjusted values are shown along with SP line profiles, or more preferably, SP contours of appropriate intervals. If a good background range is established, most anomalies are well delineated as more negative areas.

Anomalies of -450 mv, or more negative, are due to graphite, but anomalies of -350 to -400 mv can occur in a variety of lithologic or mineralized conditions. Generally, detailed follow-up readings along the strike of the anomaly can resolve some of the possibilites.

Another situation sometimes encountered during an SP survey is a line of values which are more negative than the values along the adjacent lines on each side. This means that the anomalous SP contours run along the line at right angles to the base line and also to the regional strike. This condition may either be due to a loss of control, or the presence of a crosscutting conducting body which may contain sulphides. Loss of control may be due to a sudden change in pot difference, an erroneous reading (value) of the control station, or location of the control station over an anomaly. Similar to magnetic surveys, SP surveys are better controlled from nonanomalous control stations. If control stations are to be set up on the base line, it is preferable to first survey the base line, back and forth if necessary, to establish reliable values. Then, if some parts of the base line are anomalous, these should be avoided as control stations if possible. Since slight variations in moisture or temperature can change the electrical potential of any station, it is likely that in an anomalous area the change will be greater. To determine the cause of an anomalous line of values, the readings along it should be repeated. Repeated surveys of SP anomalies due to buried conductors are generally replicative; although, they may change in strength due mainly to variations in the level of the water table. A low water table produces stronger negatives than a high water table.

If duplicate readings should substantiate that an anomaly follows along a survey line, some follow-up cross traverses perpendicular to the line may be required in order to detail the anomaly as depicted in Figure 7.

In some cases the line profiles or contours of SP values may be used to approximately indicate the direction of dip of a conducting body (see Figure 8). This is particularly so in level areas of no topographical effect or when using the canvas sample-bag method (see "Alternative Field Methods").

(5) Mineral Prospecting with the SP Method

The main procedures of the SP method are described under the heading "Conducting an SP Survey". SP prospecting may be conducted with a reel of wire; or, at a constant pot separation, depending on which is more

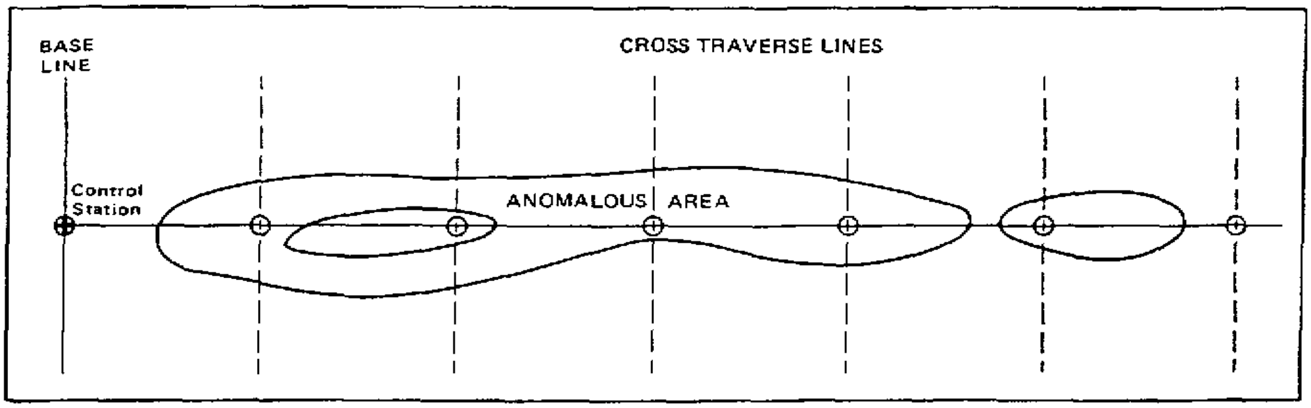

Figure 7—An example of an SP anomaly (arbitrary contour values) detailed by cross traverse lines.

convenient. Normally, it is not necessary to cut picketed grid lines for prospecting, as pace-and-compass traverses provide sufficient control over location of anomalies.

When an anomaly has been detected it should be "peaked up". This means that the forward pot is moved back along the survey line until the highest reading on that traverse line is accurately located. This may require moving the pot only a few centimetres along the line. Next, the rear pot and millivoltmeter are moved up close to the anomaly, preferably at or near a surveyed station so that the new control station can be tied-in to the rest of the survey values. As an example, the peak on the survey line in Figure 9 is -225 mv; since somewhere along strike the peak could rise to a "graphite" level, it is necessary to maintain some control over the relative magnitude of SP values. Assuming the new control station is found to be valued at -125 mv, it is possible to do a further check perpendicular to the traverse line to establish the location of the anomaly peak more accurately. If there is higher ground to the right and lower ground to the left, it is preferable to test the higher ground first by a detailed parallel traverse line some 5 to 10 m from the original survey line, as shown in Figure 9.

If a second peak of -285 mv is located to the right, this means that the best direction was chosen, and another detailed traverse line should be surveyed farther to the right. The third peak may be only -105 mv. Thus the strongest vaule is near -285 mv. Next, it is possible to pinpoint the SP target by "potting" along strike until the maxi-

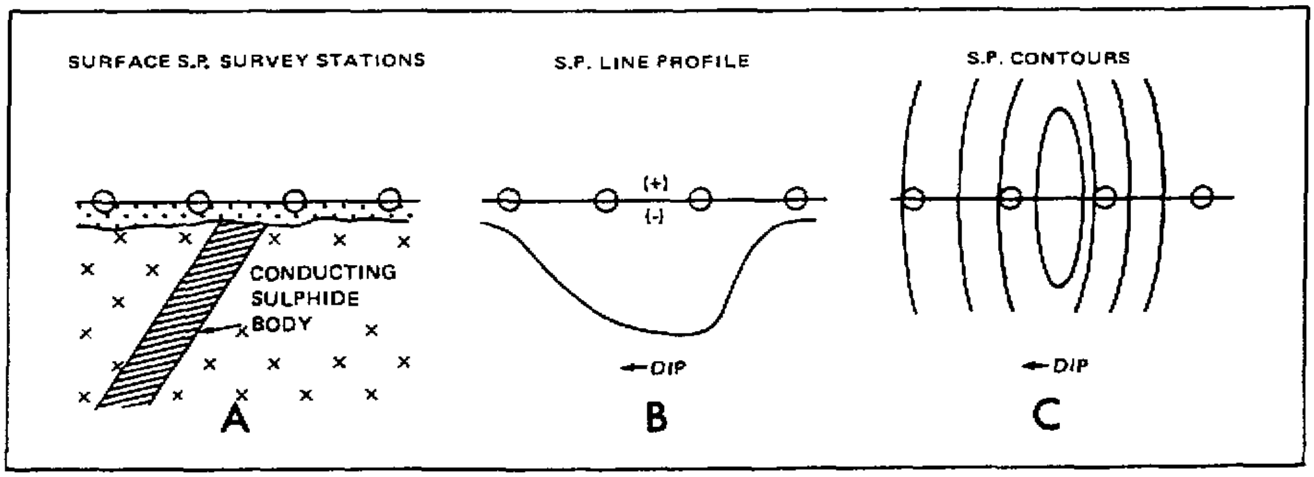

Figure 8—An example of dip determination using SP data.
*(**A**)—cross-section of a dipping sulphide body.*
*(**B**)—line profile of SP readings over (A) showing smooth gentle slope on the down-dip side and steep abrupt slope on the up-dip side.*
*(**C**)—contours of SP readings over (A) showing wider spacing interval down-dip and a closer interval up-dip.*

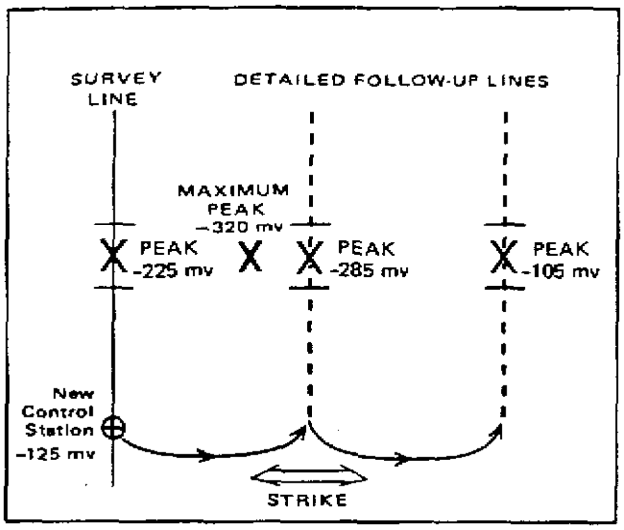

Figure 9—An example of detailed follow-up surveying used to locate a maximum SP peak.

mum peak is located, probably between the original traverse line and the -285 mv value for the above example. Assuming the highest peak value is -320 mv, this is where the source of the anomaly is closest to surface. To evaluate whether the anomaly can be exposed by stripping, it is necessary to "pot" around the highest peak by taking a dozen or so readings over an area of about 30x30 cm^2 (1 ft^2).

If the readings around the peak vary by only 1 to 5 mv within the square area, then the source of the anomaly is probably below the water table and inaccessible by ordinary overburden stripping. If the readings vary by 5 to 15 mv or more, the anomaly is above the water table and probably may be exposed by stripping off the overburden with a shovel and pick. If the peak area varies by 25 to 50 mv or more, the source of the anomaly is probably graphite which may, or may not, be above the water table.

An alternative to the grid prospecting method for surveying well-staked contiguous claims is the "spiderweb" technique illustrated in Figure 10.

Four claims can be covered from a single control station. This method is recommended for base metal prospecting in areas where only large sulphide bodies are of interest. It is not recommended for gold prospecting.

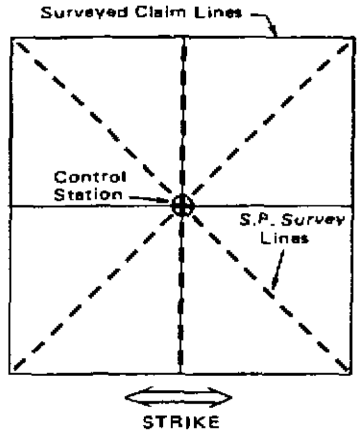

Figure 10—The "spiderweb" method of SP surveying.

CONCLUSIONS

Lang (1970, p.162) states: "Of all the geophysical methods applicable to the search for sulphides, the spontaneous polarization technique provides the quickest field procedure and also furnishes highly definite information as to the occurrence or absence of sulphide mineralization...With the exception of graphite there are but few insignificant factors to lead the geophysicist astray when interpreting the spontaneous polarization results."

Nevertheless, because varying concentrations of iron sulphide are common near the surface of the earth's crust, and are readily detected by the SP method, there may be a considerable number of SP anomalies which are due to uneconomic mineralization. Thus SP should be combined with other prospecting methods when the nature of mineralization is in doubt. Also, laboratory and field research into several important aspects of the SP method are lacking. For example, the feasibility and effectiveness of SP surveys over ice are not well established. Other areas of possible investigation include the effects of magnetic storms, the extra intensity of these storms near major iron formations, the effect of hydrothermal alteration on SP anomalies, improvement of the canvas sample-bag technique (see "Alternative Field Methods") to eliminate potentials due to varying soil acidity, derivation and refinement of topographic correction techniques, and use of the SP method to monitor earthquakes or atomic explosions.

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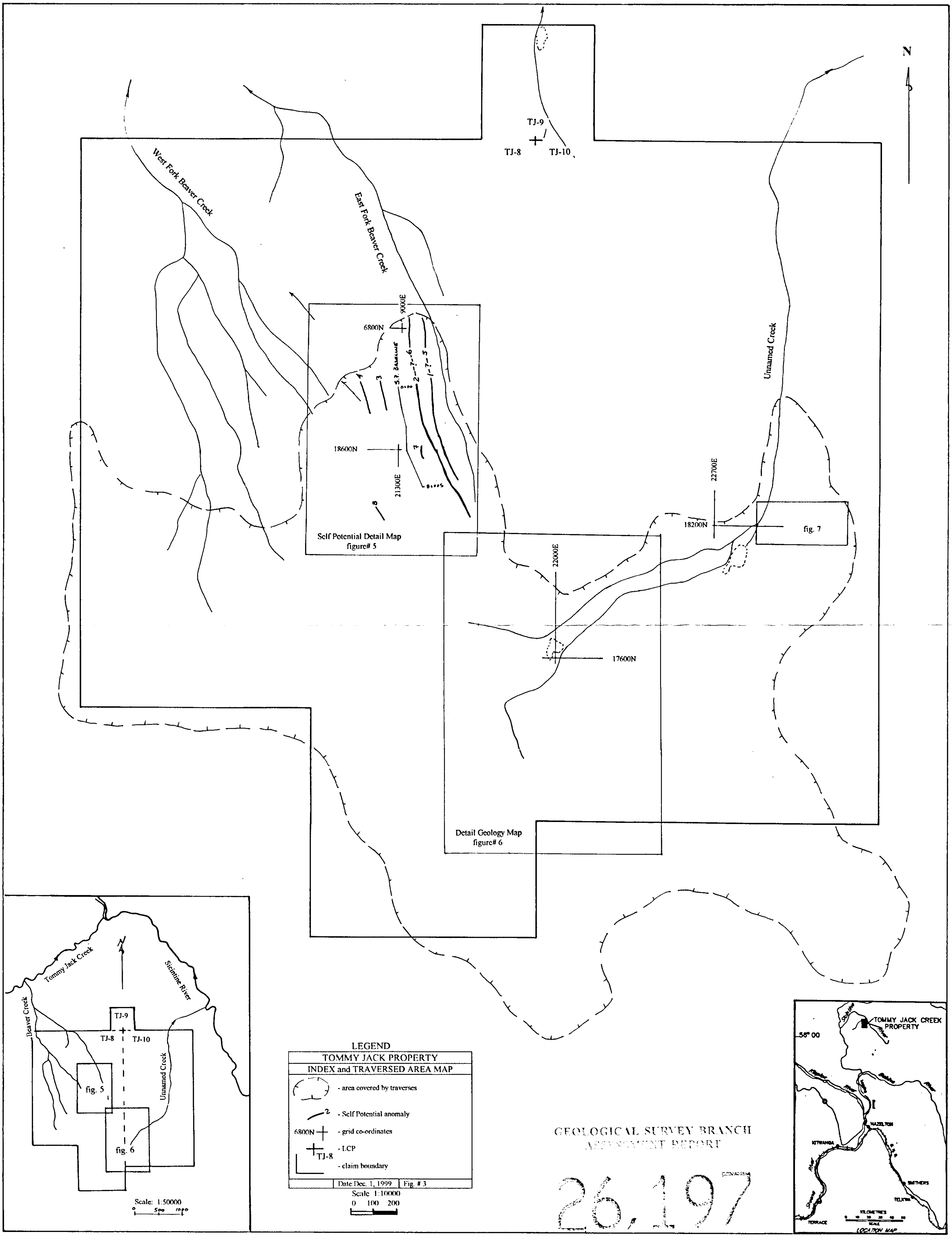

N
TJ-9
TJ-8
TJ-10
West Fork Beaver Creek
East Fork Beaver Creek
Unnamed Creek
6800N
9000E
S.P. BASELINE
18600N
21300E
Self Potential Detail Map
figure# 5
22700E
18200N
fig. 7
22000E
17600N
Detail Geology Map
figure# 6
Tommy Jack Creek
Sicintine River
Beaver Creek
fig. 5
fig. 6
Scale: 1:50000
LEGEND
TOMMY JACK PROPERTY
INDEX and TRAVERSED AREA MAP
- area covered by traverses
- Self Potential anomaly
6800N - grid co-ordinates
- LCP
TJ-8
- claim boundary
Date:Dec. 1, 1999
Fig. # 3
Scale 1:10000
0 100 200
GEOLOGICAL SURVEY BRANCH
ASSESSMENT REPORT
26,197
TOMMY JACK CREEK PROPERTY
56° 00
HAZELTON
KITWANGA
SMITHERS
TELKWA
TERRACE
KILOMETRES
LOCATION MAP

ROCK SAMPLES TOMMY JACK 1999

SAMPLE #	Au	Ag	Pb	Zn	As
TJR-1	<5	<0.2	<2	24	<2
TJR-2	85	0.4	20	30	240
TJR-3	195	0.2	10	10	162
TJR-4	100	0.2	10	28	248
TJR-5	15	0.6	32	108	394
TJR-6	<5	0.2	<2	34	38
TJR-7	<5	0.2	<2	116	32
TJR-8	<5	<0.2	2	46	8
TJR-9	<5	<0.2	<2	12	6
TJR-10	<5	0.2	2	82	20
TJR-11	<5	<0.2	2	48	32
TJR-12	<5	<0.2	<2	22	16
TJR-13	<5	<0.2	<2	<2	<2
TJR-14	<5	0.2	4	32	<2
TJR-15	<5	0.2	4	90	<2
TJR-16	<5	0.2	4	78	6
TJR-17	<5	1.4	<2	2	66
TJR-18	<5	0.2	2	16	98
TJR-19	25	0.6	2	34	132
TJR-20	<5	<0.2	2	26	88
TJR-21	<5	0.2	2	30	66
TJR-22	<5	<0.2	2	34	12
TJR-23	<5	0.2	6	52	34
TJR-24	<5	0.2	<2	108	16
TJR-25	<5	0.2	2	120	16
TJR-26	<5	0.2	2	114	8
TJR-27	<5	2.6	288	282	30
TJR-28	<5	0.2	2	90	62
TJR-29	<5	0.4	2	80	40
TJR-30	<5	<0.2	4	116	8
TJR-31	<5	0.4	12	70	70
TJR-32	<5	0.4	4	40	24
TJR-33	<5	<0.2	<2	20	64
TJR-34	<5	<0.2	<2	42	2
TJR-35	<5	<0.2	2	68	<2

o/c = outcrop(exposure), sdst = sandstone,
slst = siltstone(includes mudstone, claystone and very fine sdst),
qtz = quartz, stwk = stockwork, carb. = carbonate usually ankerite,
rep. = representative, X = across
Analytical values: Au in ppb, Ag, Pb, Zn and As are in ppm.

LEGEND

TOMMY JACK PROPERTY

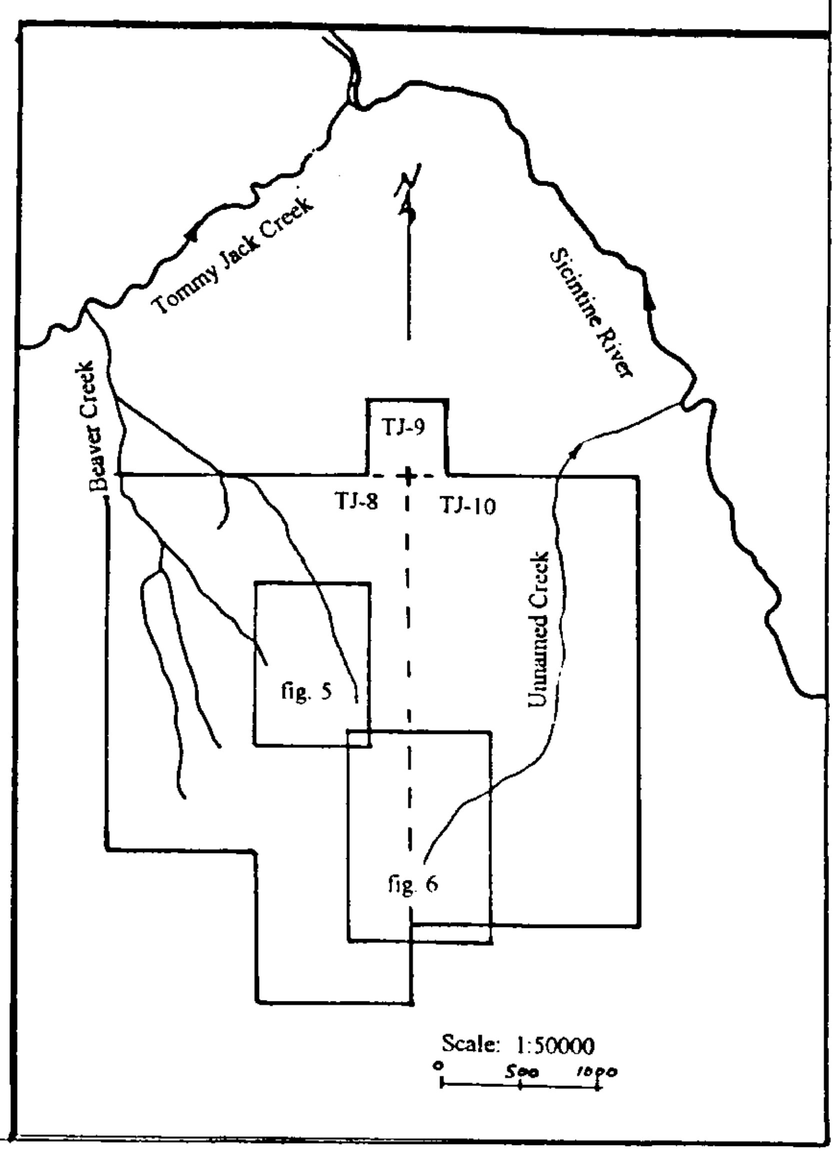
COMPILATION MAP

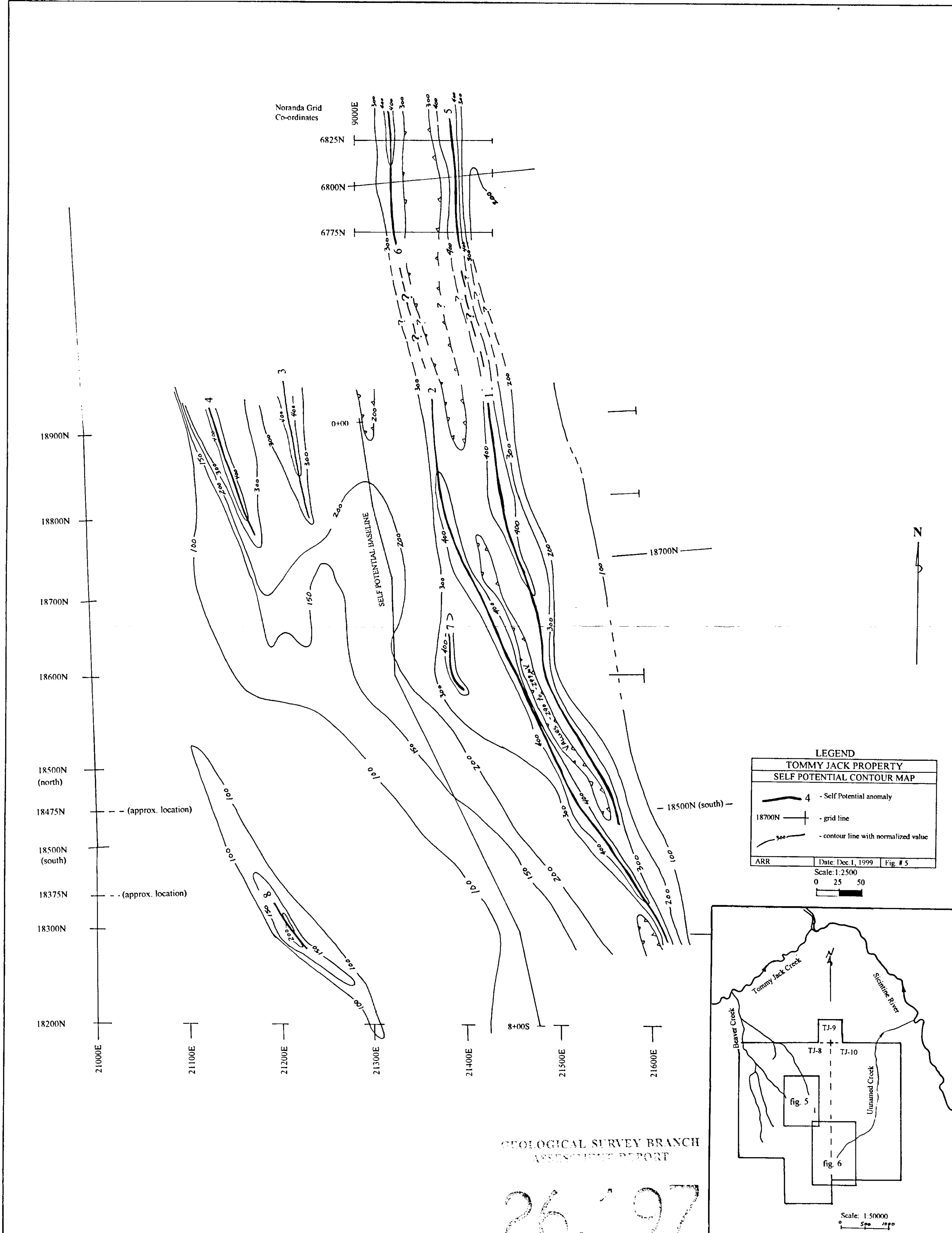
- • TJR-11 - rock sample location
- hand trench
- hand dug pit
- Self Potential anomaly
- grid line
- LCP
- claim boundary

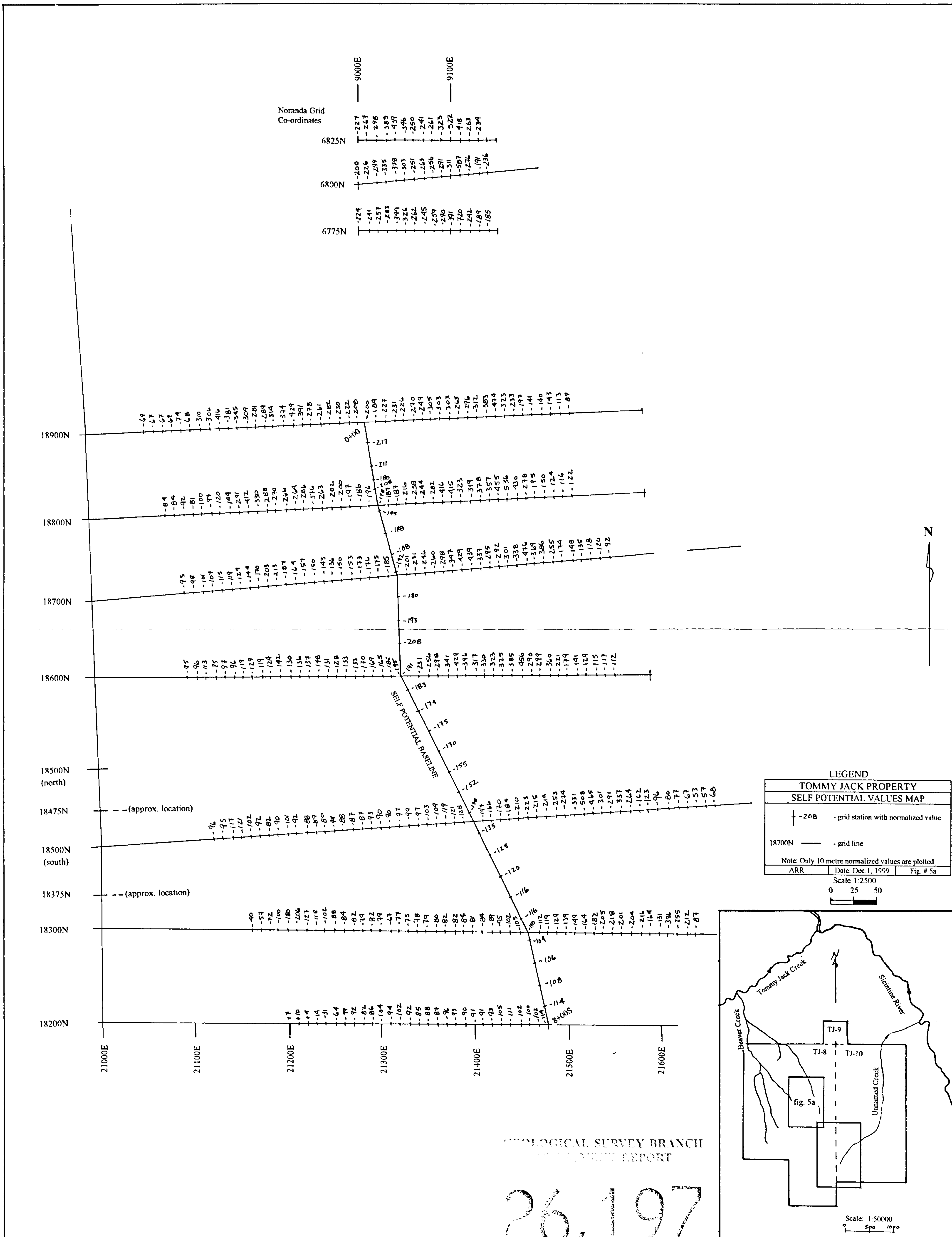
ARR	Date Dec 1, 1999	Fig # 4

Scale: 1:10000

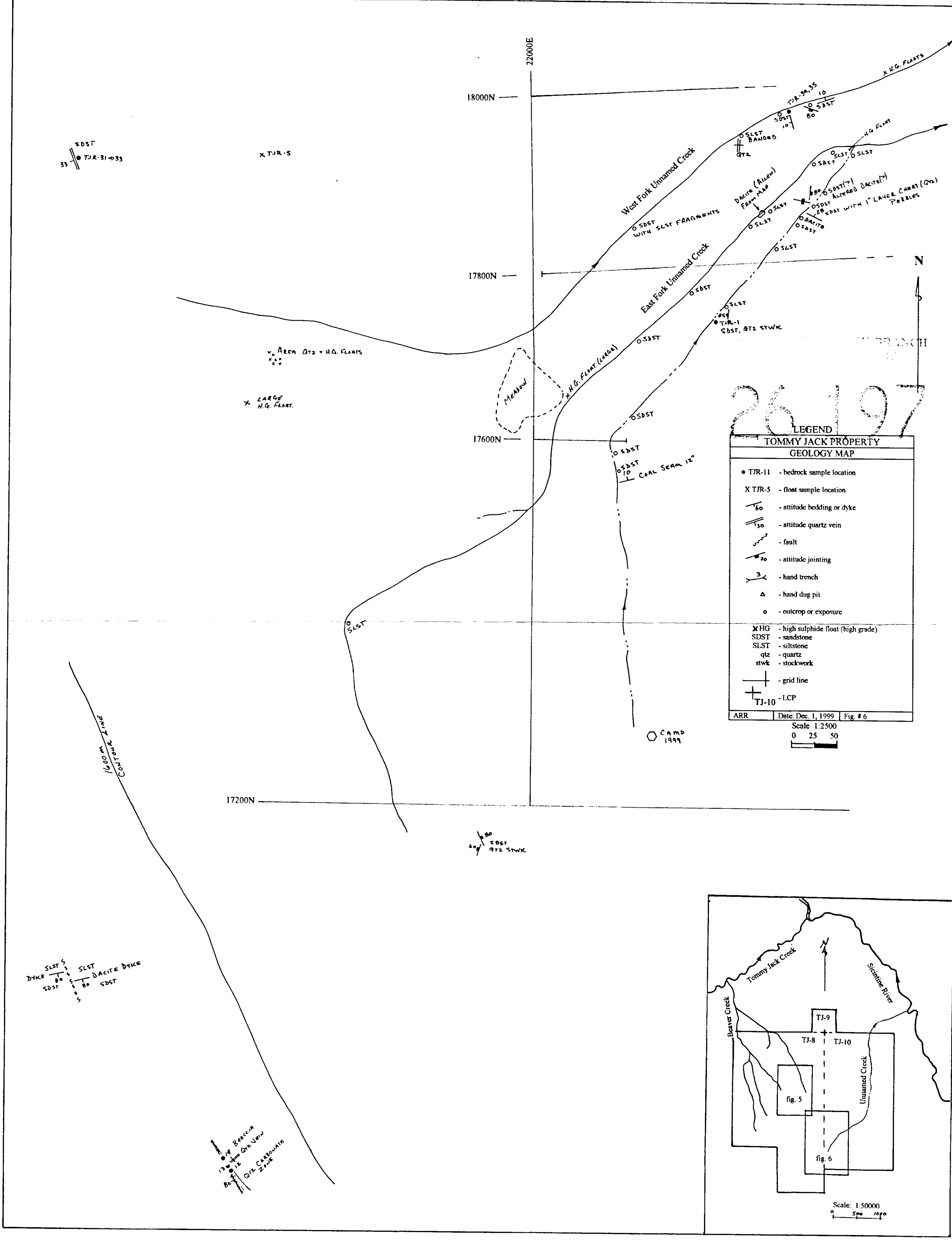
0 100 200




Noranda Grid
Co-ordinates
9000E
6825N
6800N
6775N
0+00
SELF POTENTIAL BASELINE
18900N
18800N
18700N
18600N
18500N
(north)
18475N
(approx. location)
18500N
(south)
18375N
(approx. location)
18300N
18200N
18700N
18500N (south)
8+00S
21000E
21100E
21200E
21300E
21400E
21500E
21600E
N
LEGEND
TOMMY JACK PROPERTY
SELF POTENTIAL CONTOUR MAP
4 - Self Potential anomaly
18700N - grid line
300 - contour line with normalized value
ARR
Date: Dec 1, 1999
Fig. # 5
Scale: 1:2500
0 25 50
Tommy Jack Creek
Sicintine River
Beaver Creek
TJ-9
TJ-8
TJ-10
Unnamed Creek
fig. 5
fig. 6
Scale: 1:50000
0 500 1000



9000E
9100E
Noranda Grid
Co-ordinates
6825N
6800N
6775N
18900N
0+00
18800N
18700N
18600N
SELF POTENTIAL BASELINE
18500N
(north)
18475N
— — (approx. location)
18500N
(south)
18375N
— — (approx. location)
18300N
18200N
8+00S
21000E
21100E
21200E
21300E
21400E
21500E
21600E
N
LEGEND
TOMMY JACK PROPERTY
SELF POTENTIAL VALUES MAP
-208 - grid station with normalized value
18700N - grid line
Note: Only 10 metre normalized values are plotted
ARR
Date: Dec.1, 1999
Fig # 5a
Scale: 1:2500
0 25 50
Tommy Jack Creek
Sicintine River
Beaver Creek
TJ-9
TJ-8
TJ-10
fig. 5a
Unnamed Creek
Scale: 1:50000
0 500 1000
GEOLOGICAL SURVEY BRANCH
REPORT
26,197


22000E
18000N
17800N
17600N
17200N
N
West Fork Unnamed Creek
East Fork Unnamed Creek
X H.G. FLOATS
H.G. FLOAT
X TJR-5
TJR-31→33
X LARGE H.G. FLOAT.
AREA QTZ + H.G. FLOATS
MEADOW
CAMP 1999
COAL SEAM 12"
SDST WITH SLST FRAGMENTS
DACITE (ALLEN) FROM MAP
SDST WITH 1" LAYER CHERT (QTZ) PEBBLES
ALTERED DACITE(?)
TJR-1 SDST, QTZ STWK
SDST QTZ STWK
1600m CONTOUR LINE
DACITE DYKE
BRECCIA
QTZ VEIN
QTZ CARBONATE ZONE
LEGEND
TOMMY JACK PROPERTY
GEOLOGY MAP
TJR-11 - bedrock sample location
X TJR-5 - float sample location
- attitude bedding or dyke
- attitude quartz vein
- fault
- attitude jointing
- hand trench
- hand dug pit
- outcrop or exposure
X HG - high sulphide float (high grade)
SDST - sandstone
SLST - siltstone
qtz - quartz
stwk - stockwork
- grid line
TJ-10 - LCP
ARR
Date: Dec. 1, 1999
Fig. # 6
Scale 1:2500
0 25 50
Tommy Jack Creek
Sicintine River
Beaver Creek
Unnamed Creek
TJ-9
TJ-8
TJ-10
fig. 5
fig. 6
Scale: 1:50000
0 500 1000