Geological, Geochemical and Prospecting Report

Silver Queen Project

Mining Division - Omineca

Map – 093L-059

Lat/Long – 54^{o} 34' 38" N, 126^{o} 14' 32" W

Owner/Operator - P. Walker

15781 Quick Road West
Telkwa, BC V0J 2X2

Author – A. Raven

Date – December 22, 2013

Event number: 5472628

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Summary

The field program on the Silver Queen project was carried out from September 29 to October 17, 2013 and consisted of the establishment of a control grid in order to do orientation surveys over a portion of the property. The grid consisted of a 1000 metre baseline and approximately 2700 metres of grid line with grid stations marked with flagging and a Tyvek tag with the station number. A geophysical survey, self potential, was run to determine if an SP survey would be of benefit to help determine the location of additional sulphide bearing quartz-carbonate under the overburden. Also a series of "B" horizon soil samples were collected at each grid station for future analysis of the soil pH to determine if variations in the ph could help to locate sulphide veins especially if the pH and SP results could be correlated. Informal traverses were carried out to determine if a prospecting/geological mapping program would be beneficial.

Upon calculating the SP results it was concluded that the SP data is inconclusive but the author thinks that it is beneficial to expand the grid to the southeast and to run a series of readings parallel to the baseline (NW/SE) over the same area as already surveyed. This would help to establish if the vein structures are striking in a more north/south direction. The variance in the readings is quite sufficient to indicate an anomaly, if there is one, especially with the relatively small amount of pyrite and chalcopyrite reported in the historic vein systems. There are two possibilities interpreted for the indefinite results within the survey; the incorrect orientation of the grid and the significant ground water in the area of the grid. Some of the historical data indicated that the vein systems were oriented NW/SE and this is why the grid was set out with the grid lines at right angles to the strike of the veins but this NW/SE orientation may not be the case in the survey area. The SP data suggests there may be sulphide zones oriented in a more north/south strike direction. Significant ground water, swamps, creeks and seepages, can also affect the SP survey, even though field notes were collected regarding slope angle and soil moisture further field investigations will be needed to help with the interpretation.

The soil survey consisted of collecting "B" horizon samples at each grid station for pH analysis once these samples were dried and prepared for processing in "town". The samples have been dried and are in storage awaiting processing and analyzing. The analysis has not been carried out at the time of this writing as there needs to be some clarification on the analytical methodology.

Conclusions

The program was successful in establishing the usefulness of a detailed SP survey in the area to help determine the location of sulphide bearing vein structures within the overburden covered areas. Even though the present SP results are difficult to plot (anomaly) there is sufficient variation in the values to define an anomaly if the survey can be oriented to cross the buried targets at a steeper angle. It is hoped that the pH analysis of the "B" horizon soils collected may correlate with the SP results but this remains to be determined. The survey to date is too small to determine if the pH can be correlated to the SP results. The traverses carried out during the program determined that a detailed prospecting and mapping program would be beneficial.

Recommendations

An expansion of the control grid should be carried out; to cover the south east extension of the McCrae lineament, to aid in controlling geological mapping of exposures, for expansion of the self potential survey and for expansion of the soil sampling program.

Introduction

Location and access

The Silver Queen project is located northwest of Mt McCrea between elevations of 975 metres and 1522 metres A.S.L., 7.5 kilometres north-east of Topley B.C. The town of Topley is situated 40 km east of Houston BC on the Yellowhead highway (Highway 16) which connects Prince George to Prince Rupert B.C. Access to the property from Topley is via the Granisle-Babine Lake highwayfor 4.5 km, then north-easterly on an old gravel road, suggested 4 wheel drive vehicle, for approximately 5 km to the area of the old Golden Eagle workings. This old gravel road traverses a portion of the claims in the initial survey area and leads to the Golden Eagle workings area.

Topography, vegetation and climate

The area ranges in elevation from 975 metres to 1522 metres with andesite ridges outcroppings and the depressions filled with glacial till. Pine stands, now bug killed, cover most of the area with spruce and balsam in the wetter areas. With so much of the pine now dead, the forest canopy has been removed allowing for a profuse growth of the underbrush. The once minor patches of alder and buck brush have now become prolific which will reduce production of grid development thereby increasing costs significantly. The climate is typical for the northern interior plateau with below freezing average temperatures between November and March with light to moderate precipitation at lower levels.

Exploration history

The principal old workings in the area, Silver Cup (Minfile # 093L-016) and the Golden Eagle (# 093L-015), were developed in the 1930's. The old workings consist of shafts, adit, trenches and pits that exposed some of the high grade silver showing in the area. Since the 1930's various companies have carried out further exploration work in the general area attempting to define a resource sufficient to support a commercial operation. These include a major program by Bishop Resources from the early to late 1980's (AR #s 10,656 and #16,193), with some minor programs carried out by some of the adjacent property holders.

The present claims were staked by P. Walker and associates over a period of several years beginning in November 2009 until March 2013.

Samples were collected by the property owner in July 2010 from trench debris that returned values of 0.86 g/t Au, 3837 g/t Ag, and 28.4% Pb. This debris was on the surface of a reclaimed trench, inadvertently trenched on the Walker property, by a neighboring property owner. The person that excavated and reclaimed the trench was not forthcoming with his observations nor did he notify Walker of the transgression even after he had refilled the trench. Therefore no data is available concerning the bedrock exposed in the trench.

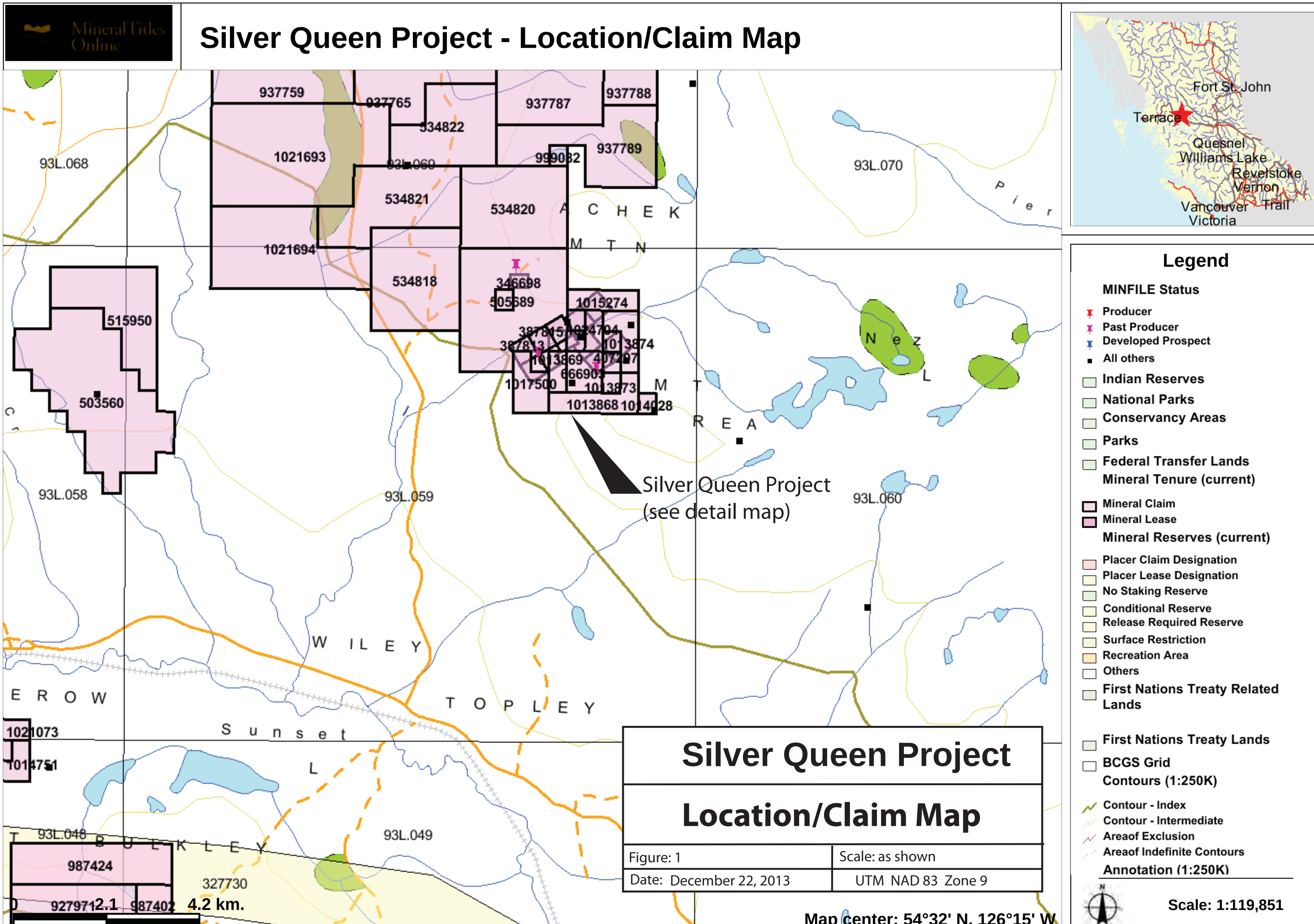
High Range Exploration Ltd, Alan Raven with the assistance the property owners, carried out a multi-phase orientation program consisting of; prospecting to determine the extent of the bedrock exposure in the northwest portion of the claims and to determine the frequency of the bedrock exposures in the southern portion of the claims, establishment of a preliminary control grid for a mapping, geophysical and geochemical surveys, an initial self potential survey to determine the practicality of using this method to locate any additional veins in the overburden covered areas and the collection of a series of "B" horizon soil samples for pH analysis at a later date. This program was carried out in the fall of 2013 from September 29 to October 17, 2013. Detailed geological mapping was not carried out at this time but only reconnaissance to determine if detailed mapping is warranted.

Claim status

Tenure #	**Claim Name**	**Record Date**	**Good to date***	**Area**
666903	Silver Queen	2009/Nov/09	2015/Nov/15	74.99
1013868	Shadow	2012/Oct/20	2015/Nov/15	112.50
1013869	Shadow 2	2012/Oct/20	2015/Nov/15	37.49
1013873	Shadow 3	2012/Oct/20	2015/Nov/15	18.75
1013874	Shadow 4	2012/Oct/20	2015/Nov/15	74.97
1013875	Shadow 5	2012/Oct/20	2015/Nov/15	18.75
1014028	Richfield	2012/Oct/27	2015/Nov/15	18.75
1015238	SQ	2012/Dec/11	2015/Nov/15	18.75
1015274	Rich North	2012/Dec/12	2015/Nov/15	74.96
1015289	Richer	2012/Dec/13	2015/Nov/15	18.74
1017500	Rich West	2013/Mar/04	2015/Nov/15	93.74
1017754		2013/Mar/13	2015/Nov/15	18.75

* assuming acceptance of this report

Silver Queen Project - Location/Claim Map



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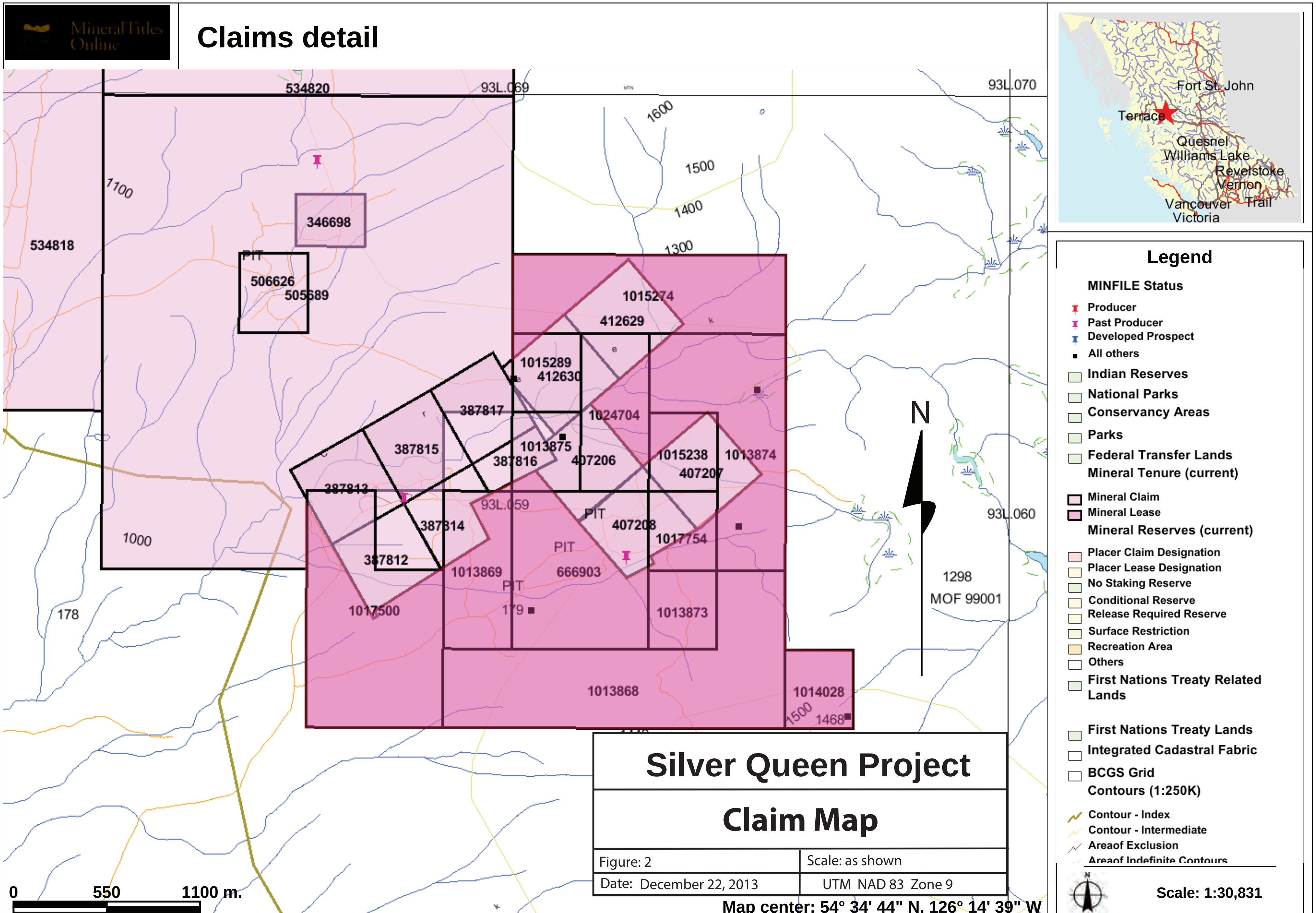

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Geology

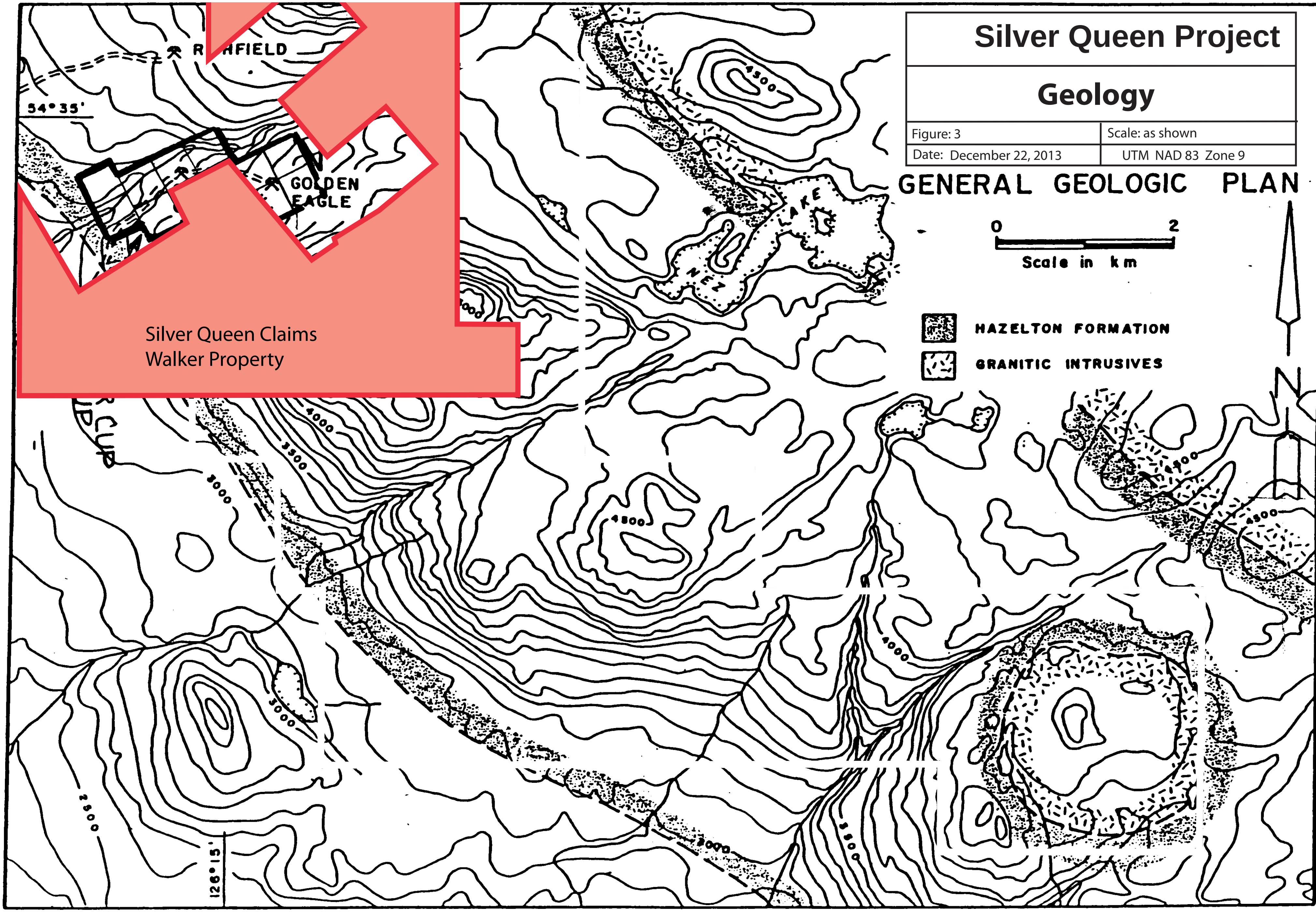
Regional and property geology

The property is underlain by volcanic fragmental rocks of the Jurassic-Cretaceous Age possibly belonging to the Hazelton Group, Telkwa Formation (GSC Map 671A "Houston and GSC O.F. 351, Smithers BC). The volcanic rocks are composed of rhyolites, andesites, andesite porphyry and andesite breccia with included tuffs. Regional metamorphism has produced a talc-chloritic alteration in these rocks that forms a silicified, chloritic schist form of volcanics. There are exposures of Topley intrusions, consisting of quartz monzonite, quartz diorite, granodiorite and monzonite, in the area. There are exposures of water lain sediments, argillites, sandstone and shale, within some of the water courses within the claim block.

The Silver Cup area, located to the northwest of the Silver Queen grid, chalcopyrite, sphalerite, and galena are associated with quartz carbonate veining and extensive sericitic alteration while to the northeast of the grid, the Golden Eagle area, narrow veins and fracture fillings carry high concentrations of silver in the form of tetrahedrite (AR #16,193). The traverses carried out in this program located primarily andesitic rocks with minor exposures of sedimentary (?) rocks in some of the creek beds.

See appendix "B" for a detailed description of the area geology

Geology from AR# 20,948



Work Program 2013

Objectives

This initial exploration program carried out on this project had the objectives of determining; if a self potential (SP) survey would help delineate the sulphide bearing veins on the property, the collection of a series of "B" horizon soils could be tested for a pH signature in the deep overburden and to prospect the area for any outcrop of bedrock. If a combination of SP and pH data could be used in the area, especially the deep overburden, this would provide an economical way for the independent prospector to narrow the search areas before any mechanical trenching was instigated.

Program

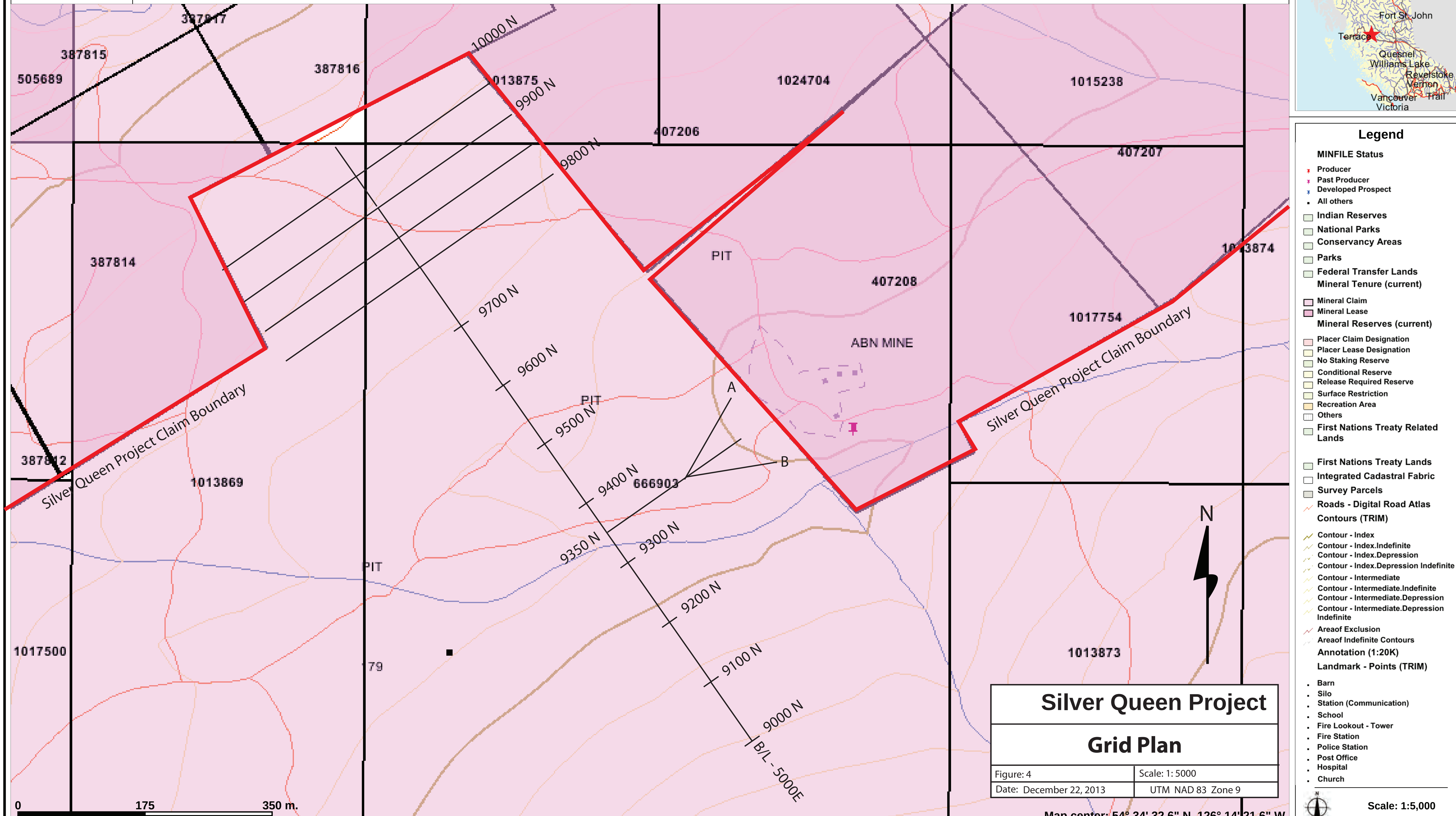
The field program was carried out by High Range Exploration Ltd, with assistance from the property owner from September 29 to October 19, 2013. A total of seven days were spent in the field.

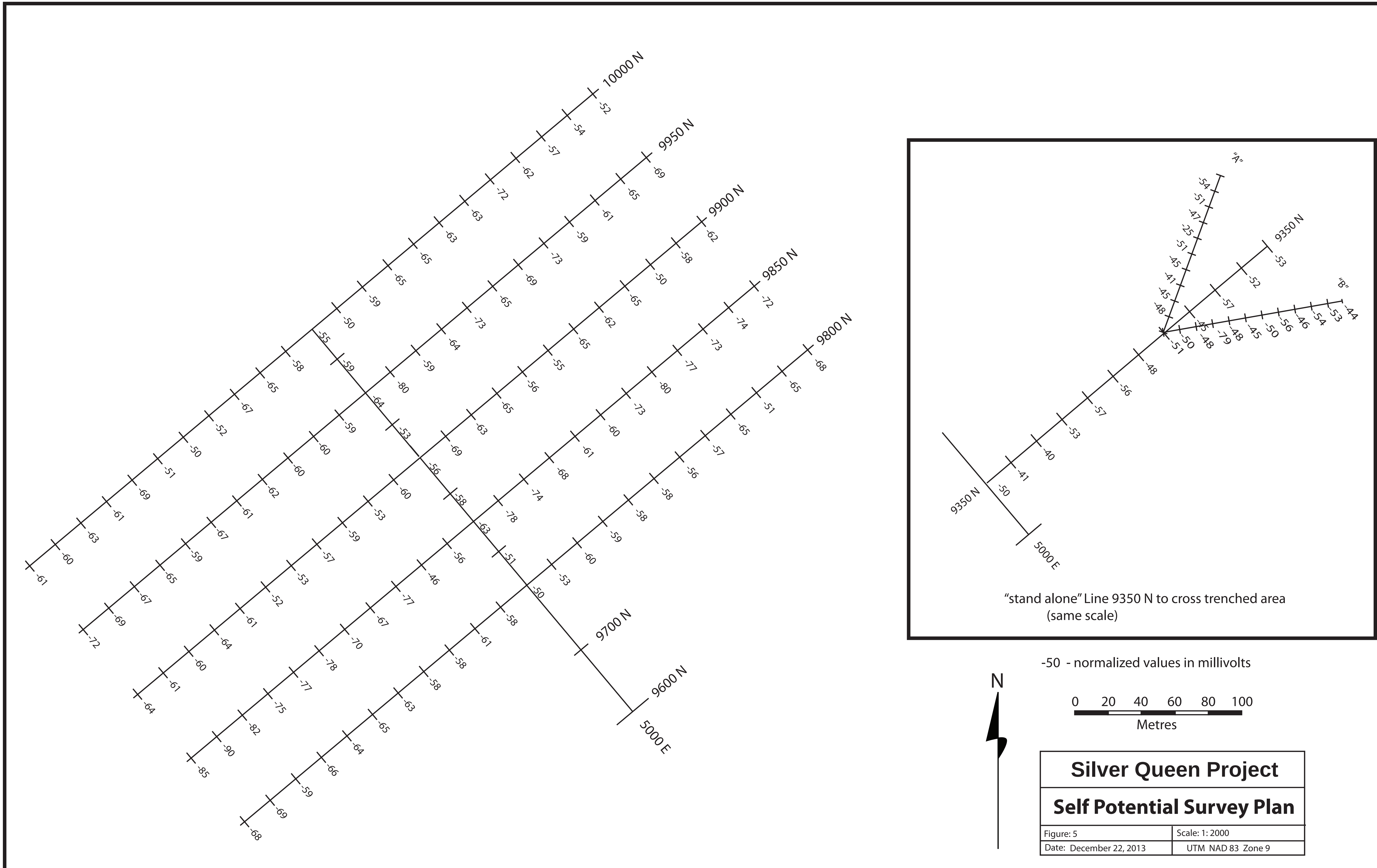
The program consisted of the establishment of a control grid for a geophysical survey (self potential – SP), soil sampling and geological mapping/prospecting (to be carried out at a later date). This was an orientation program to determine if an SP survey would be beneficial to help locate the sulphide bearing quartz-carbonate veins in the area. The grid consisted of a brushed out baseline of 1000 metres and approximately 2700 metres of slope corrected (hard chained) survey lines. The self potential survey covered the northern portion of the grid as well as a single "stand alone" line situated at 9350 N, with 20 metre spaced readings on the cross lines and 25 metre spaced readings on the baseline. Soil samples were collected at all the stations on the grid for later pH analysis. These were air dried and are in storage awaiting clarification of methodology of analysis. Also during the field work, the boundaries of the legacy two post claims were located and flagged where they restricted the dimensions of the survey grid. Methodology used in this survey was the "canvas bag method" as laid out in Barr (Appendix ??)

Grid Station / UTM co-ordinate correlations

Grid Station		UTM Co-ordinate (Zone 9 NAD 83)	
Easting	**Northing**	**Easting**	**Northing**
5000	9800	0678104	6051330
4780	9800	0677943	6051176
5220	10000	0678127	6051613
4780	10000	0677807	6051306
5220	9950	0678153	6051581
4780	9950	0677844	6051274
5220	9900	0678193	6051546
4780	9900	0677883	6051232
5220	9850	0678230	6051149
5220	9350	0678568	6051145

Silver Queen Project - detail




10000 N
9950 N
9900 N
9850 N
9800 N
9700 N
9600 N
5000 E
"A"
"B"
9350 N
5000 E
"stand alone" Line 9350 N to cross trenched area
(same scale)
-50 - normalized values in millivolts
N
0 20 40 60 80 100
Metres
Silver Queen Project
Self Potential Survey Plan
Figure: 5
Scale: 1: 2000
Date: December 22, 2013
UTM NAD 83 Zone 9

Discussion of results

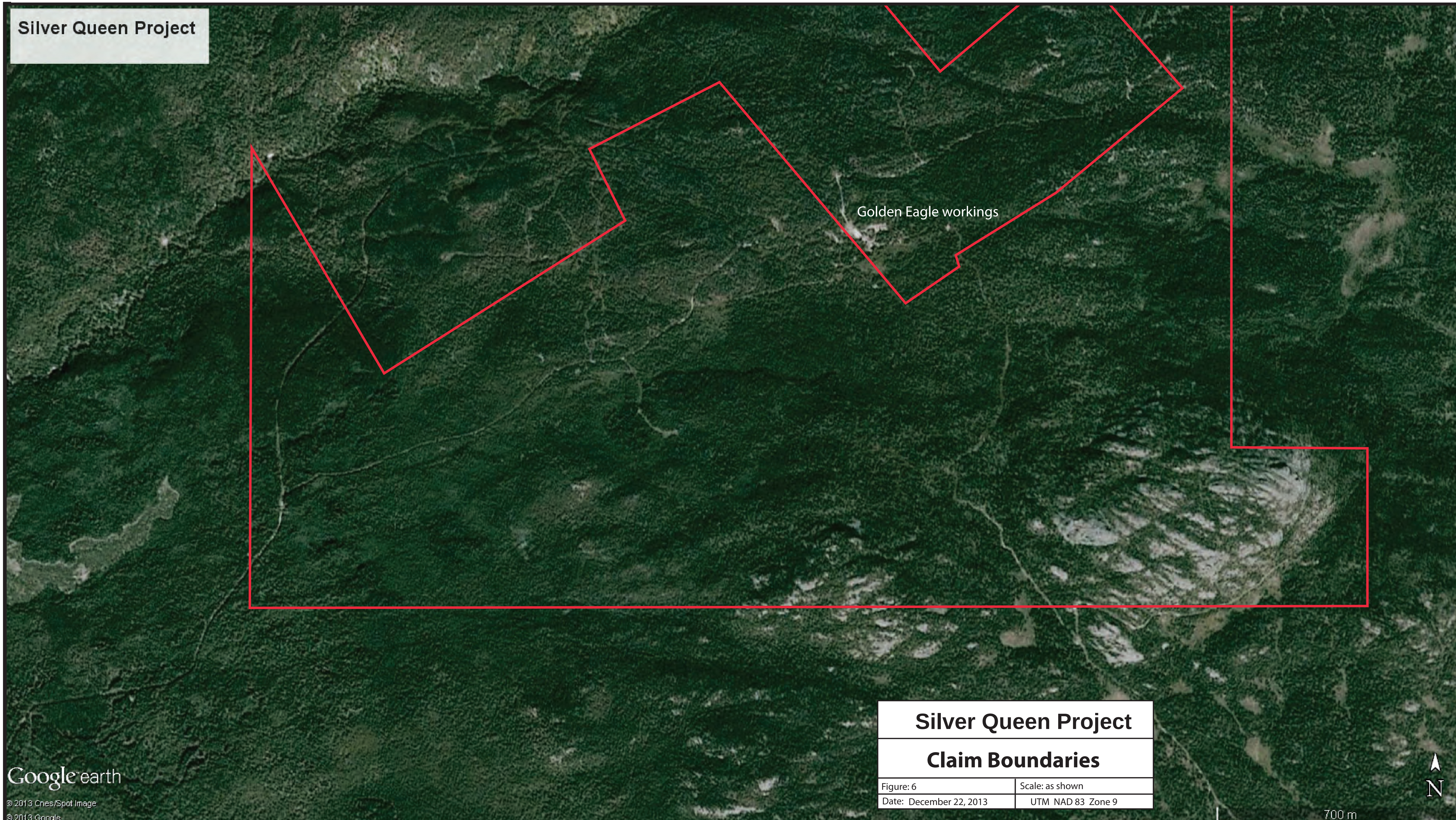
The program carried out in the fall of 2013 had the primary focus of an orientation survey to help the owner and this author to determine an appropriate way to explore the property in a cost effective way especially during these challenging times.

The Self Potential survey has merit as the values (readings) have sufficient variation to determine "anomalies" within the area. As discussed earlier the difficulties with interpretation at this time relates to a number of factors; small size of the survey, the possibility that a different orientation of the grid lines would be more effective and the surprising amount of wet and swampy ground within the survey area. Swampy or wet soil conditions will complicate interpretation of the results but can be handled effectively with a diligent survey. The results were not contoured as the author thinks that the grid should be re-oriented so the grid lines (reading sites) are more parallel to the regional structure, approximately 140 degrees, in order to delineate the SW/NE striking cross structure that carry some of the known mineralization in the area. Preliminary research of the Golden Eagle showings indicated a NW/SE strike to the vein systems but further detailed research also indicated some of the high grade silver vein systems in the general area have a NE/SW strike.

A series of soil samples, "B" horizon, were collected for later pH analysis. These samples were dried and stored until the methodology for analysis has been clarified.

There is a possibility that SP results combined with soil pH may be effective in determining some sulphide mineralization in overburden covered terrain. This possibility remains to be proven but it is worth the effort considering that these surveys are cost effective for the small operator.

Prospecting traverses over the general area revealed that there is more bedrock exposure in the area than was predicted by discussions with the property owner and some of the research. The author noticed in his traverses that some of the small drainages have bedrock exposures that are not obvious but can be located with careful prospecting. Also noted was that the amount of flowing water on the soil covered slopes indicate that the overburden is not very deep. Noticed in the traverses was the proliferation of old logging trails that would facilitate ready access to the area for mechanical trenching or drill program.


Silver Queen Project
Golden Eagle workings
Google earth
© 2013 Cnes/Spot Image
© 2013 Google
Silver Queen Project
Claim Boundaries
Figure: 6
Scale: as shown
Date: December 22, 2013
UTM NAD 83 Zone 9
N
700 m

Statement of costs

Exploration Work type	Comment	Days			Totals
Personnel (Name)* / Position	**Field Days (list actual days)**	**Days**	**Rate**	**Subtotal***	
Alan Raven/Prospector	Sept 29/30, Oct 4/5/6/12/13/17	8	$400.00	$3,200.00	
P. Walker/assistant/property owner	Sept 29/30, Oct 5/6/12/13	6	$150.00	$900.00	
				$4,100.00	**$4,100.00**
Office Studies	**List Personnel (note - Office only, do not include field days**				
General research	A. Raven	2.5	$300.00	$750.00	
Report preparation	A. Raven	2.0	$300.00	$600.00	
				$1,350.00	**$1,350.00**
Airborne Exploration Surveys	**Line Kilometres / Enter total invoiced amount**				
Other (specify)			$0.00	$0.00	
				$0.00	**$0.00**
Remote Sensing	**Area in Hectares / Enter total invoiced amount or list personnel**				
Other (specify)			$0.00	$0.00	
				$0.00	**$0.00**
Ground Exploration Surveys	**Area in Hectares/List Personnel**				
Geological mapping					
Regional		*note: expenditures here*			
Reconnaissance	approx 35 ha/A. Raven	*should be captured in Personnel*			
Prospect		*field expenditures above*			
Underground	Define by length and width				
Trenches	Define by length and width			$0.00	**$0.00**
Ground geophysics	**Line Kilometres / Enter total amount invoiced list personnel**				
Electromagnetics					
SP/AP/EP	**SP survey - approx 2700 metres**				
IP					
AMT/CSAMT					
				$0.00	**$0.00**
Geochemical Surveying	**Number of Samples**	**No.**	**Rate**	**Subtotal**	
Soil	*note: This is for assays or*		$0.00	$0.00	
Rock	*laboratory costs*		$0.00	$0.00	
Transportation		**No.**	**Rate**	**Subtotal**	
truck rental		7.00	$60.00	$420.00	
kilometers			$0.00	$0.00	
ATV		3.00	$80.00	$240.00	
fuel		7.00	$45.00	$315.00	
				$975.00	**$975.00**
Accommodation & Food	**Rates per day**				
Meals	day rate or actual costs-specify		$0.00	$0.00	
				$0.00	**$0.00**
Miscellaneous					
Telephone			$0.00	$0.00	
				$0.00	**$0.00**
Equipment Rentals					
Field Gear (Specify)			$0.00	$0.00	
				$0.00	**$0.00**
Freight, rock samples					
			$0.00	$0.00	
				$0.00	**$0.00**
TOTAL Expenditures					**$6,425.00**

Bibliography

Assessment and Progress Report on the Topley Property – Phendler, R.W. P.Eng. 1982, AR# 10,656

Diamond Drilling Report on the Silver Cup property – Davidson, D.A. P.Eng, 1990 – AR# 20,648

Independent Technical Report on the Topley-Richfield Polymetallic Property – Caracle Creek International Inc –Wetherup, S., P.Geo and McKenzie, J., P.Geo – unpublished report

Reconnaissance Geochemical Soil and Recon Geological Survey on the Spring Group – Stanley, C.H. 1987, AR# 16,193

Topley-Richfield Gold/Silver Deposit for L. Warren – Carter, N., PhD, P Eng, 1998 – unpublished report

Various Minister of Mines Annual Reports from 1911 to 1962

Statement of Qualifications

ALAN R. RAVEN

I have been directly involved in the mineral exploration industry as a prospector and exploration field manager since 1969.

Between 1972 and 2011 I have taken a variety of prospector's courses and exploration short courses.

My field exploration experience includes geochemical and geophysical surveying, diamond drilling, prospecting, geological mapping, crew training and exploration program design, implementation and management in British Columbia and the Western United States (Washington, California, Nevada, Arizona and Utah)

I authored this report using data P. Walker and my own research

This Assessment Report is an accurate account of the 2013 exploration program as carried out by High Range Exploration Ltd (Alan Raven) from September 29 to October 17, 2013.

Dated at Smithers, B.C. this 22nd day of December 2013

__Alan R. Raven______
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Appendix A

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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Manuscript approved for publication (March 15, 1981) and published with the permission of E.G. Pye, Director, Ontario Geological Survey

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

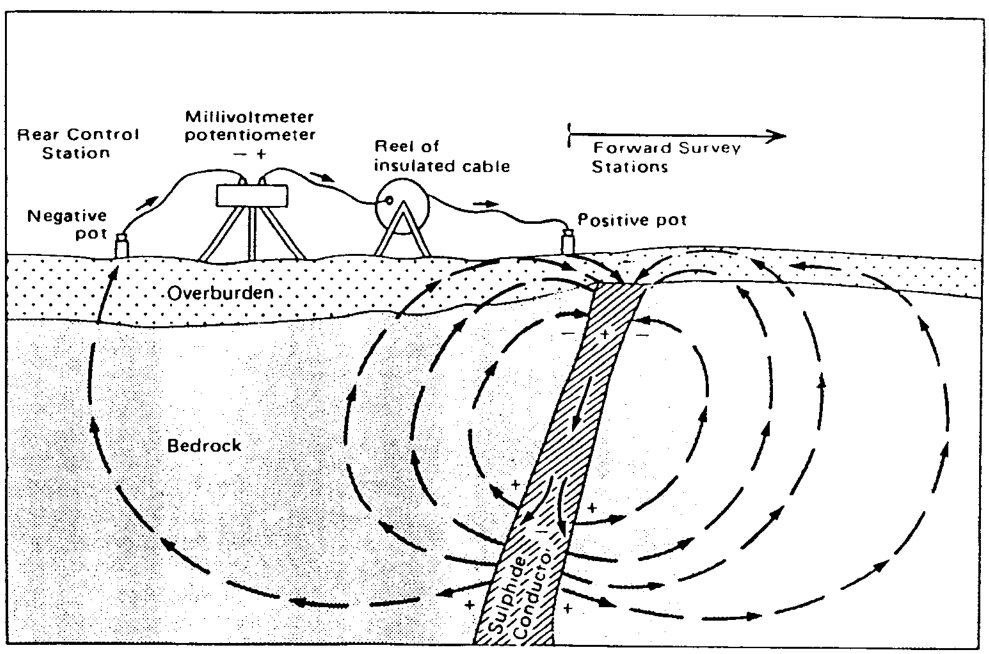


Figure 1—Schematic representation of spontaneously generated electric current flow near a sulphide body, showing current paths through the ground and the SP apparatus (after Lang 1970)

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."

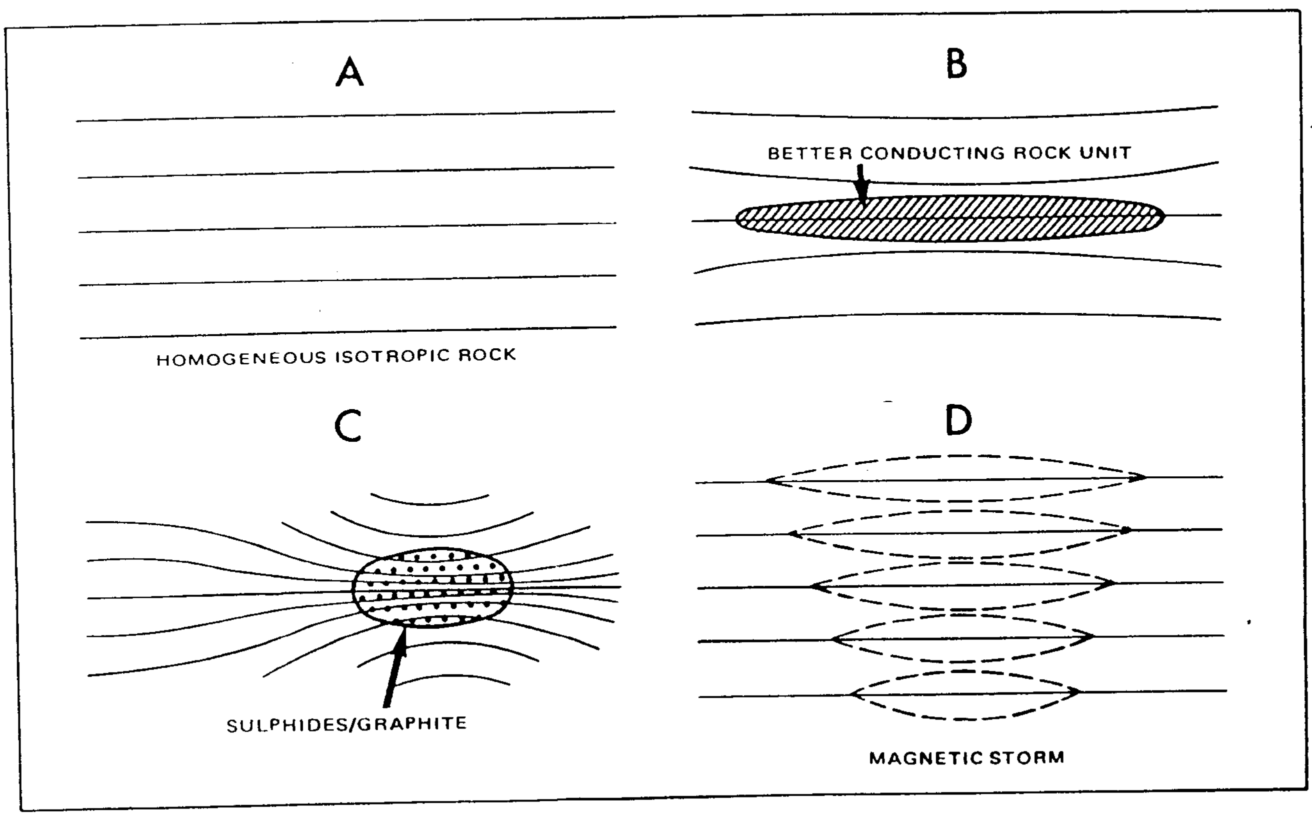


Figure 2—Schematic representation of various naturally occurring configurations of electrical equipotential fields.

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 solution 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

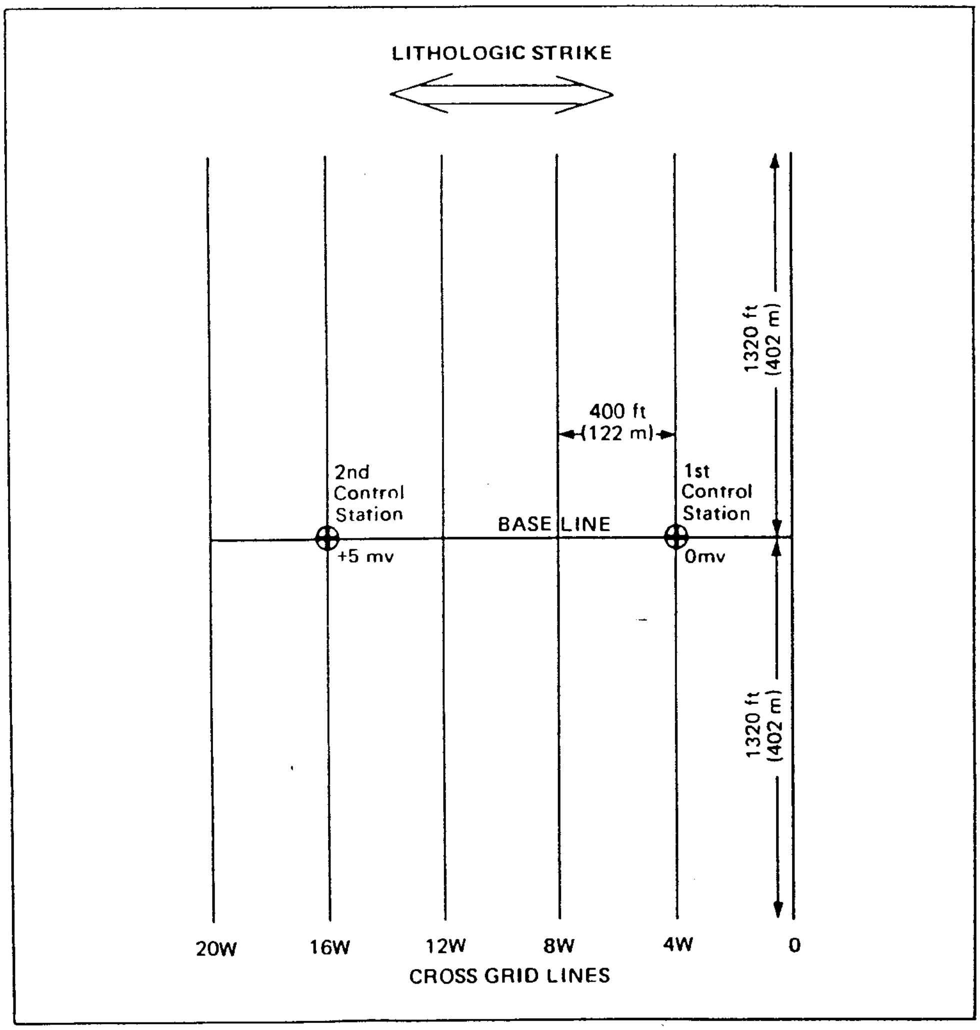


Figure 3—An example of logistical details for an SP survey conducted with 610 m (2000 ft) of wire (see also Table 1).

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

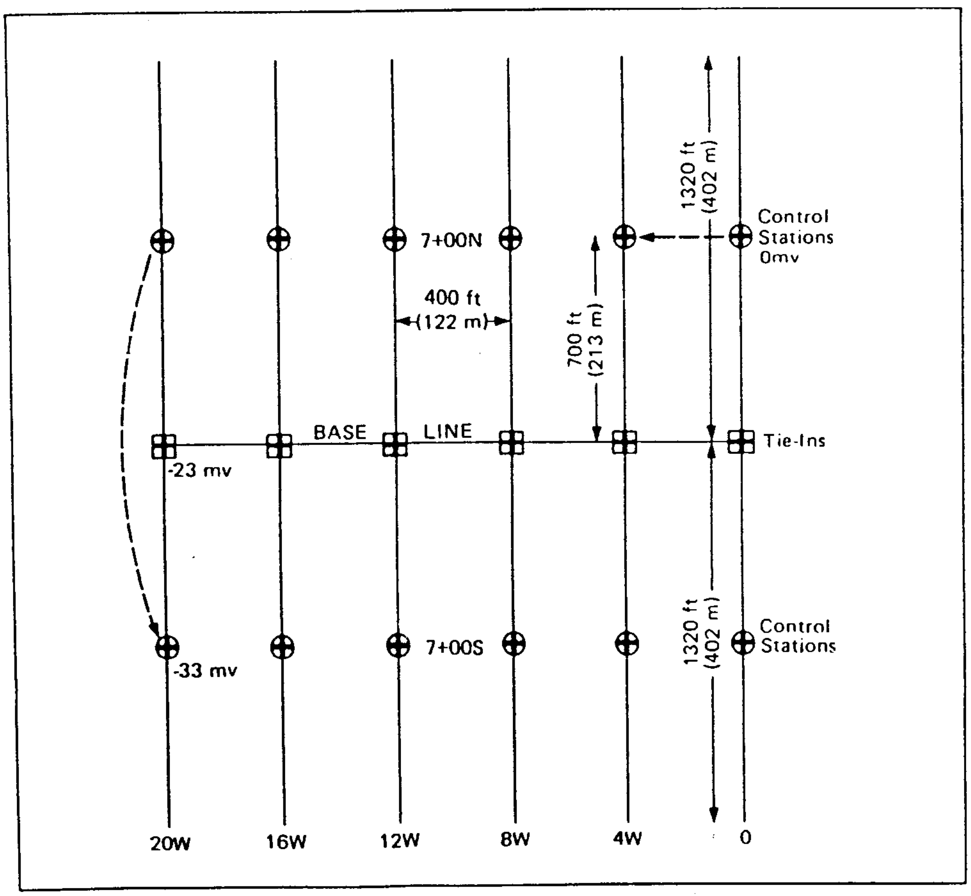


Figure 4—An example of logistical details for an SP survey conducted with 244 m (800 ft) of wire.

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

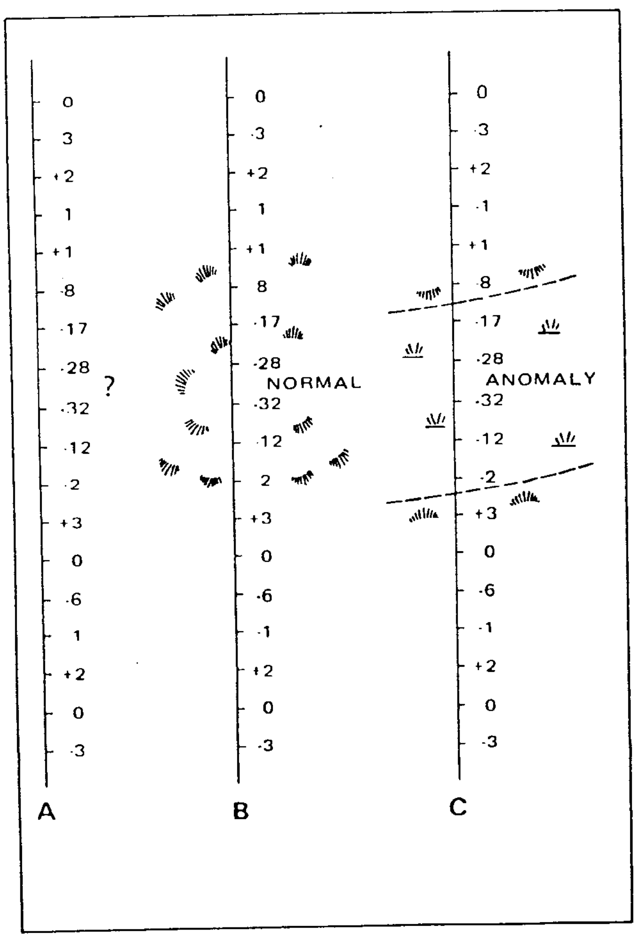


Figure 5—Theoretical SP readings showing the effects of topography.

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-

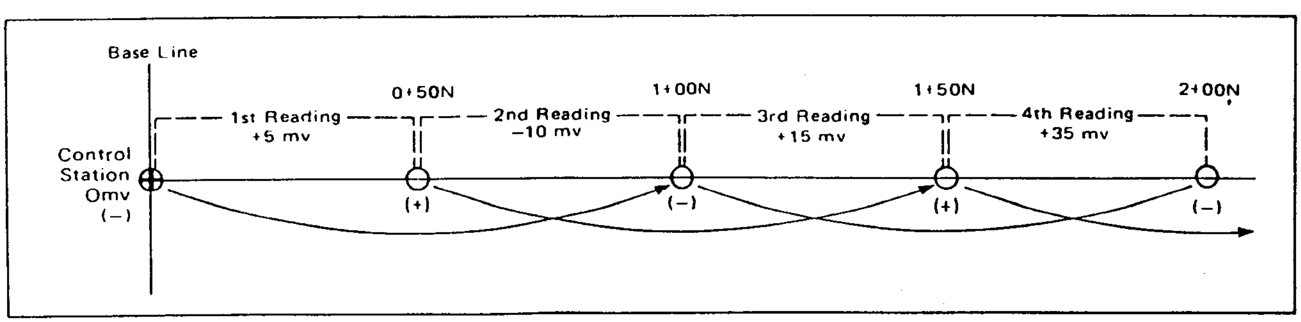


Figure 6--An example of the "leapfrog" method of SP surveying with a fixed length of wire (see also Table 2).

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 particlularly 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

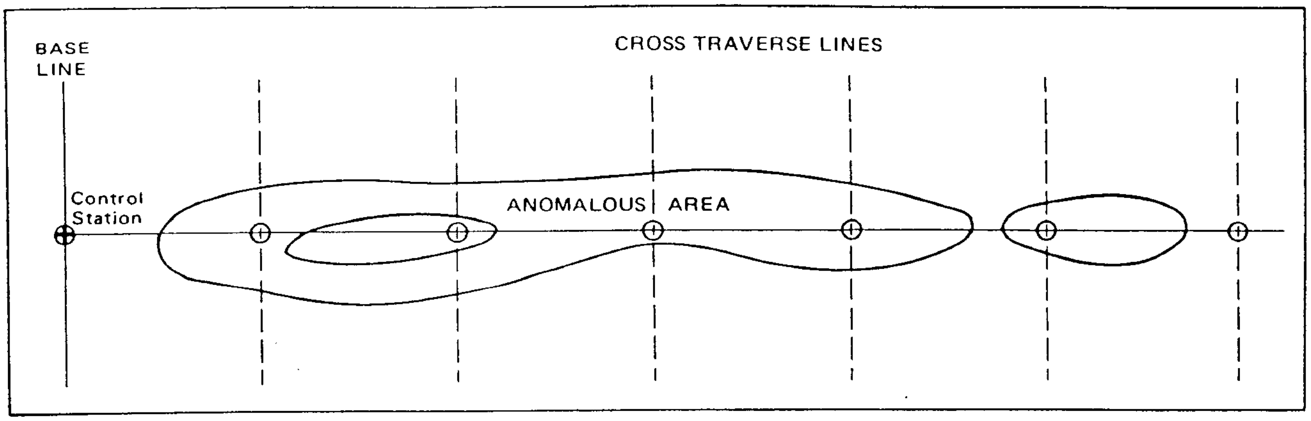


Figure 7—An example of an SP anomaly (arbitrary contour values) detailed by cross traverse lines.

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-

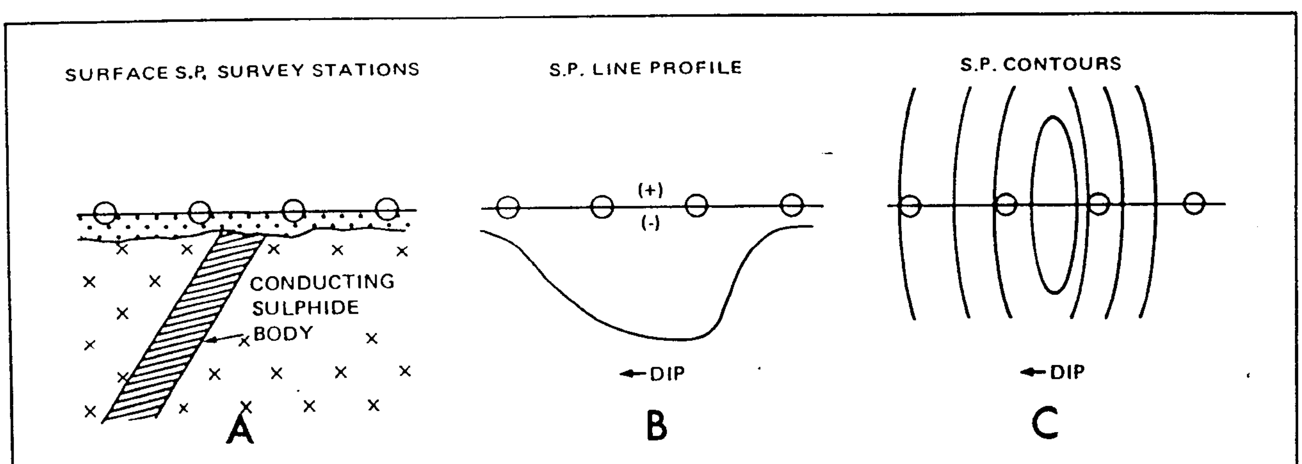


Figure 8—An example of dip determination using SP data.
(A)—cross-section of a dipping sulphide body.
(B)—line profile of SP readings over (A) showing smooth gentle slope on the down-dip side and steep abrupt slope on the up-dip side.
(C)—contours of SP readings over (A) showing wider spacing interval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

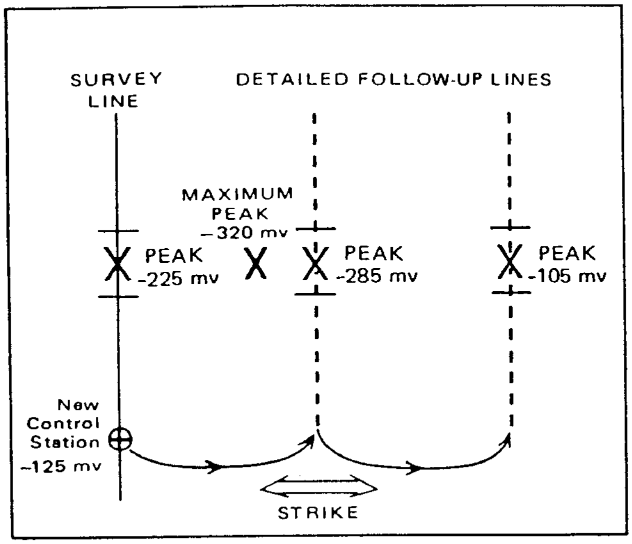


Figure 9—An example of detailed follow-up surveying used to locate a maximum SP peak.

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.

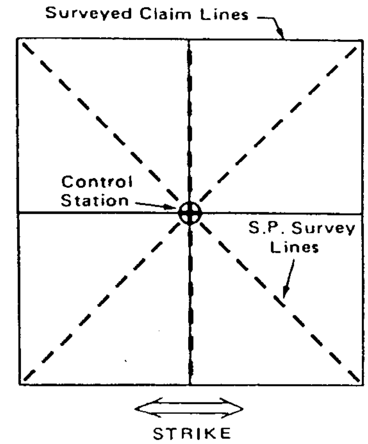


Figure 10—The "spiderweb" method of SP surveying.

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."

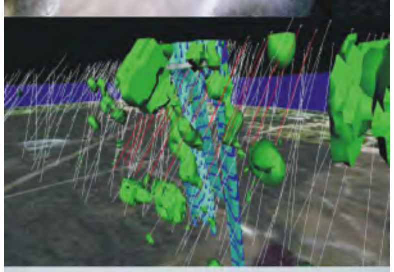
Nevertheless, because varying concentrations of iron sulphide are common near the surface of the earth's crust, and are readily detected by the SP method, there may be a considerable number of SP anomalies which are due to uneconomic mineralization. Thus SP should be combined with other prospecting methods 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.

Appendix B










INDEPENDENT TECHNICAL REPORT

TOPLEY-RICHFIELD POLYMETALLIC PROPERTY

Omineca Mining Division
British Columbia, Canada

Industry. Recommended. Professionals.

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February 8th, 2011

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Stephen Wetherup, B.Sc., P.Geo.
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Hole TRE08-10 and 11 were collared to test the East Vein along strike to the south and a possible third vein structure. It appears that the vein in the trench was intersected in hole TRE08-10 at 10.25 m and 31.00 m, and represents the East Vein. However, mineralization in these areas is weak. This is likely due to the lack of a NE trending fault in this area. However, a NE trending fault appears to occur on the west side of the section containing these two holes. Mineralization and alteration located deep in hole TRE08-11 is adjacent to this NE trending structure. This NE structure is the likely the same NE trending fault that coincides with mineralization in the historical Topley-Richfield workings (Figure 6-5).

Holes TRE08-13 and TRE08-14 were both drilled to test the southern strike extent of the NNW trending fault structure that hosts mineralization in the Topley-Richfield workings. Both of these holes contained significant amounts of strong Fe-carbonate alteration down their entire lengths. Also, both holes contained zones of weak Au-Ag mineralization and moderate base metal mineralization and may suggest a metal zonation in the hydrothermal system. Hole TRE08-14 encountered a significantly wider interval of Zn mineralization and represents a different style of mineralization instead of discrete veins to disseminated sulphide and stockwork and closely spaced veinlet mineralization. This style of mineralization is reminiscent of the mineralization described at the Equity Silver mine.

6.3.5 Reclamation - 2008

Surface disturbance during the drill program was kept to a minimum by utilizing existing drill access trails and only ~250 m of new trails were constructed. During the drilling program sumps were excavated to contain all the drill cuttings and silt fencing erected to ensure that silt and drill cuttings stayed within the confines of the drill pads and trails and did not enter any natural water drainages.

Upon completion of the program all drill set-ups and trails were smoothed out and sumps back filled and any bare spots were seeded with grass seed (ñreclamation mixò) and fertilizer applied to ensure quick re-growth.

7.0 GEOLOGICAL SETTING

7.1 Regional Geology

The Topley-Richfield Property is located in the Intermontane Belt of British Columbia and underlain by Stikine volcanic arc Terrane rocks (Figure 7-1). This Terrane consists of the following groups (MacIntyre *et al*., 1987):

Hazelton Group (Early to Middle Jurassic):	andesitic volcanic and volcaniclastic rocks and related marine sedimentary rocks
Takla Group (Middle to Late Triassic):	augite basalt, andesite, and related marine sedimentary rocks
Asitka Group (Carboniferous to Permian):	island arc metavolcanic rocks and limestone

The accretion of the Stikine Terrane occurred in the Middle Jurassic. Post-accretionary rocks overlying the Stikine Terrane (and the Skeena arch) include the Late Jurassic Bowser Lake and the Early Cretaceous Skeena Groups (fluvial and deltaic sedimentary rocks) in the northwest, the Late Cretaceous to Early Eocene Kasalka Group (porphyritic andesite, basalt, rhyolite and related pyroclastic rocks) and the Bulkley plutonic suite in the west. In the Babine Lake area, the Early Eocene Newman Formation (porphyritic andesite flows) overlies the terrane and the Babine Lake suite plutons intrude it. In the south, the Nanika plutonic suite intruded the terrane.

The Hazelton Group hosts the Topley-Richfield Property. The Hazelton Group is subdivided into four formations (MacIntyre *et al.*, 1987):

Smithers Formation:	sandstone, siltstone, felsic tuff
Nilkitkwa Formation:	(a) red epiclastic rocks and amygdaloidal flows
	(b) rhyolitic volcanic rocks
	(c) conglomerate, tuff, siltstone
	(d) argillite, chert limestone
Saddle Hill Formation:	(a) pyroxene basalt flows
	(b) basaltic tuff
	(c) tuffaceous sandstone
	(d) ash flow tuff
Telkwa Formation:	(a) polymictic conglomerate
	(b) porphyritic andesite
	(c) fragmental volcanic rocks
	(d) phyllitic maroon tuff

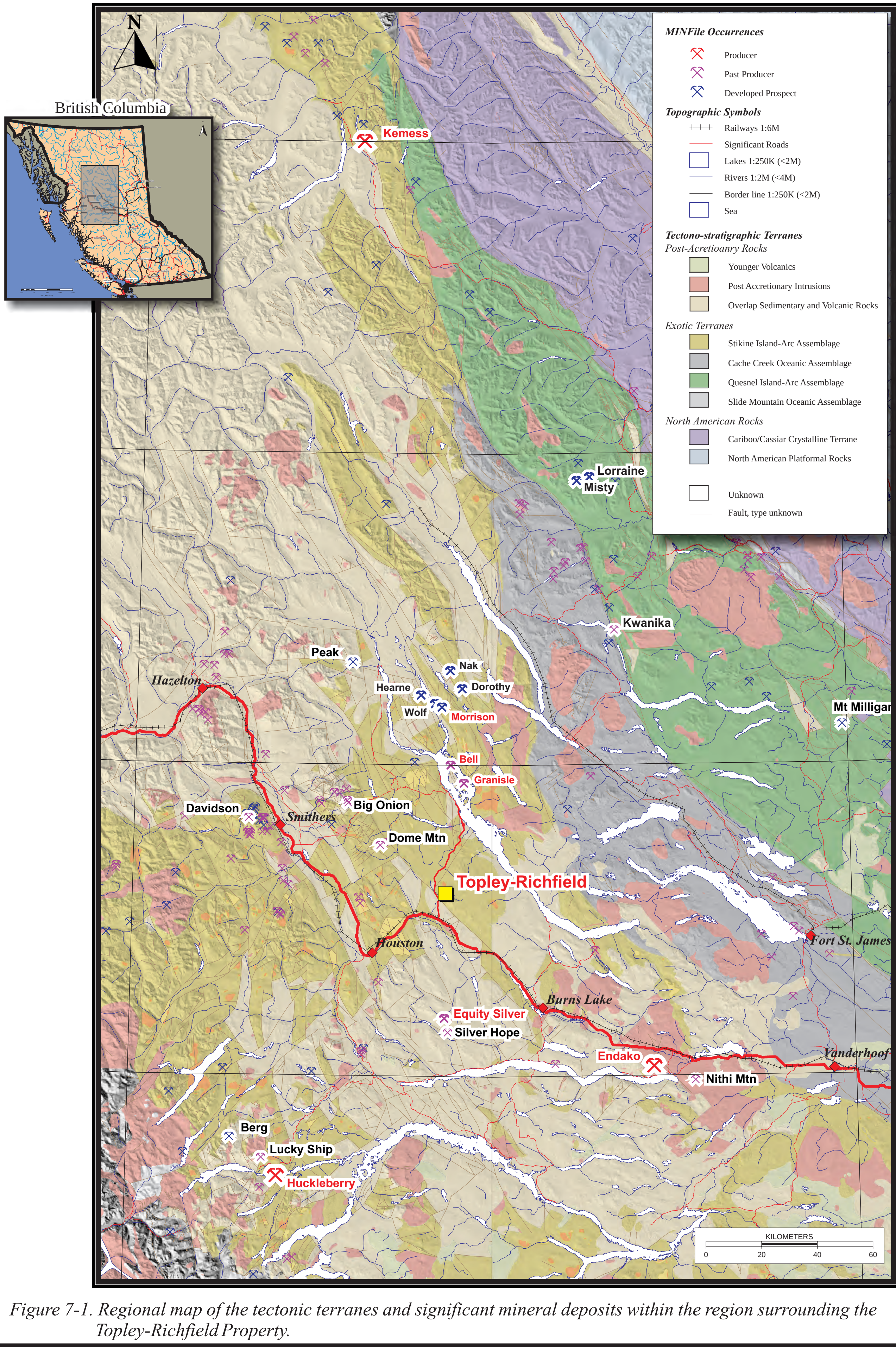
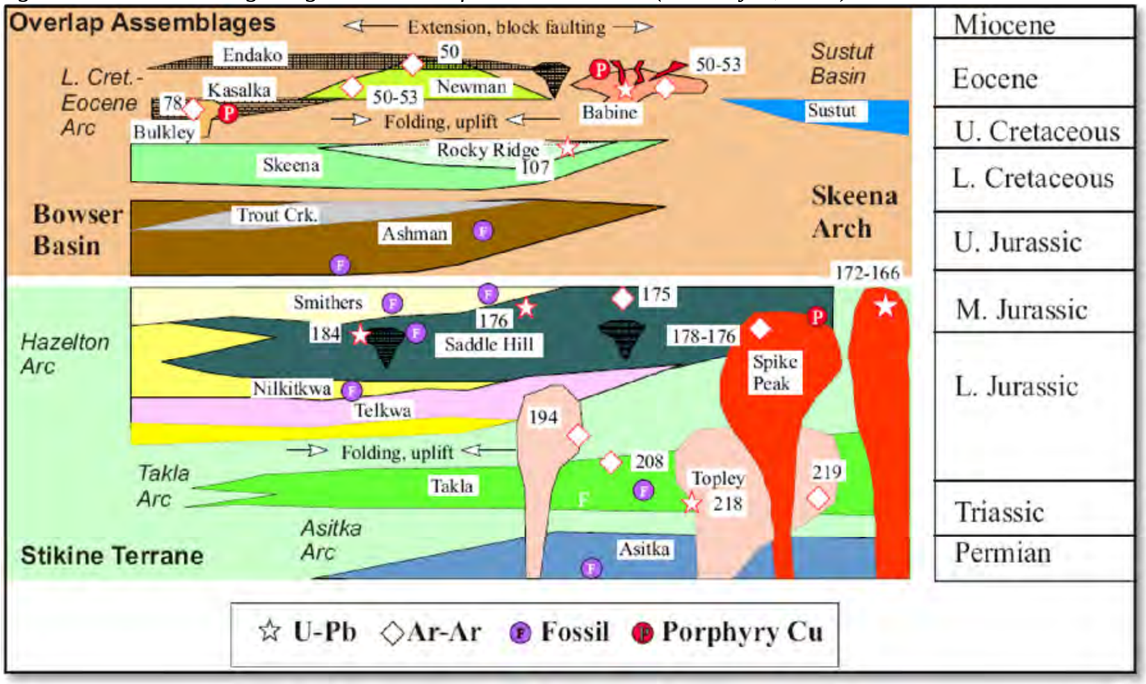


Figure 7-1. Regional map of the tectonic terranes and significant mineral deposits within the region surrounding the Topley-Richfield Property.

Figure 7-2. Schematic geological section of the Skeena Arch (MacIntyre, 2005).



Another period of mineralization within the region is the Eocene where felsic volcanism and related intrusive activity emplaced the Babine Porphyry deposits (e.g. Bell, Granisle, and Morrison) as well as several epithermal Au-Ag-Cu-Pb-Zn vein and disseminated sulphide deposits (e.g. Equity Silver). Units commonly associated with this age of deposits are the Babine Intrusions and associated Newman volcanic rocks (Figure 7-2).

Structurally, the area is part of basin-and-range type horst and graben structures. Westward imbricate faulting marks terrane boundaries and is offset by complex Late Cretaceous to Eocene high-angle faults. In addition, broad open folds occur in the area.

7.2 Property Geology

The Property is covered by approximately 1 to 30 m overburden comprising glacial till and soil as shown by drill core data (except in Findlay Creek valley and west slope of Mt Tachek; MacLeod, 1988). MacLeod (1988) describes the dominant rock types based on drill core data and the few outcrops (from top to bottom):

1. epiclastic rocks

2. ñultramafic tuffò(?): pale to light green matrix with pyroxene porphyroclasts re-interpreted to be intermediate to felsic volcaniclastic lahar and tuff flows

3. argillite: interbedded with the volcanic rocks

4. fragmental andesitic volcanic: lapilli tuff, lithic and feldspar tuff, dark to pale green

5. massive andesite: fine-grained, dark green, locally fragmental, feldspar and hornblende-phyric, locally altered to quartz-biotite-magnetite, locally altered to epidote-chlorite-quartz-carbonate.

The lower three units are interpreted to belong to the upper Telkwa Formation and the upper two units were interpreted by McLeod (1988) to be part of the Nilkitkwa Formation. These upper two units were encountered during the drilling program in 2008 and are almost un-lithified with abundant polymicitic lahar material and highly friable smectitic (locally bright green celadonite, mis-identified by McLeod as mariposite) andesite tuff which are likely much younger than Mesozoic and are likely Tertiary Newman volcanic rocks. Typical of Newman volcanic rocks these unconsolidated volcanic rocks commonly contain 0.5 to 1 cm euhedral biotite books. These Tertiary volcanic rocks appear to overlie the main mineralization across a moderately SW dipping fault structure and appear to occupy a NW trending half graben feature.

Abundant float boulders, comprising intrusive rocks that possibly belong to the Topley Intrusive Suite, were observed on the Property during the current phase of exploration but none have been observed in outcrop or within the drill core.

Hydrothermal quartz-sericite-carbonate (calcite, dolomite, ankerite) alteration is reported to occur in two zones roughly at the fault contact between the Newman volcanic rocks and the Telkwa formations, and the mineralization is generally hosted by the silicified and carbonate altered Telkwa formation rocks. The altered rocks were referred to as ñTopleyiteò in previous descriptions of the Property. Argillite is reported to occur in the altered zone, but they are less altered than the andesitic volcanic rock. However, where the argillite is silicified the mineralization is typically stronger. Breccias are reported to occur in the altered zones, but they could be fragmental volcanic rocks rather than true hydrothermal breccias.

The above description of rocks from the Topley-Richfield Property is from MacLeod (1988), whoôs interpretations are based on drill core logging. CCIC could not verify whether the rock types were identified correctly. Logging strongly altered rocks and interpreting the protolith is exceedingly difficult and should be taken into account when defining a geological model.

The strata of the Hazelton Group in the area strike northward and dip 45º-55º toward the west and are interpreted to strike NNE around the historical workings. Post-mineral faulting was inferred from drilling and faults trend west to southwest.

7.3 Structure

An interpretation of the geophysical data collected by NXA Inc., (Wetherup, 2009) suggests that the NNW trending features originally interpreted to be stratigraphic layering are actually normal fault structures and the stratigraphic layering within the Telkwa Formation appears to strike northï northeast and dip steeply WNW. Outcrops on the Topley-Richfield Property are rare and an investigation of the structures present south of the Property identified several structures.

1. NNW to N trending normal fault structures that dip moderately westward and commonly host quartz-Fe-carbonate-pyrite veins and quartz-carbonate alteration,
2. NE to ENE trending oblique faults which dip steeply north and are associated with quartz-carbonate alteration but rarely host veins,
3. NW trending strike-slip faults which do not appear to be associated with mineralization or alteration, and
4. NNE trending steeply NW dipping primary bedding in the Mesozoic Stikine Terrane rocks (Telkwa Formation).

IP-Mag data and drainage patterns clearly delineate many of the first three sets of structures however the bedding is a more subdued feature (Figures 6-2 and 6-3).

8.0 DEPOSIT TYPE

The area of the Skeena Arch is one of the best mineralized areas of British Columbia (MacIntyre, 2006). It hosts a plethora of deposit types including polymetallic base and precious metal veins; porphyry, epithermal and skarn deposits; sedimentary exhalative (ñSEDEXò) and volcanogenic massive sulphide (ñVMSò) deposit types.

The Property was previously classified as a VMS deposit because of the apparent stratabound nature of the mineralized zone (e.g., Whiting, 1981). However, upon revisiting the geological information, CCIC has identified that the Property mineralization style has many similarities to epithermal deposits and the reported conformable nature of the mineralized zone could be due to the development of preferred mineralization along zones of structural weakness.

Appendix C

SELF POTENTIAL DATA

PROJECT: SILVER QUEEN　　　　Page 1

COMMENTS: BASE STATION - 9800N 5000E VALUE "0"

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
9800N	5000E	∅	< 1.°		0		-50	-50	BASE ST. "0" mV
9825		-1			0	-1		-51	
9850		-13			0	-13		-63	
9875		-8			0	-8		-58	
9900		-6			0	-6		-56	
9925		-3			0	-3		-53	
9950		-14			0	-14		-64	
9975		-9			0	-9		-59	
10,000N	5000E	-5			0	-5		-55	
9775	5000E	-11			0	-11		-61	
9750		-4				-4		-54	
9725		-9				-9		-59	
9700		-10				-10		-60	
9675		-6				-6		-56	
9650		-7				-7		-57	
9625		-4				-4		-54	
9600	5000E	-6			0	-6	-50	-56	
9800N	5000E	∅			∅		-50	-50	
	5020	-3				-3		-53	
	5040	-10				-10		-60	
	5060	-9				-9		-59	
	5080	-8				-8		-58	
	5100E	-8				-8		-58	
	5120	-6				-6		-56	
	5140	-7				-7		-57	
	5160	-15				-15		-65	(?)
	5180	-1				-1		-51	(?)
	5200E	-15				-15		-65	
	5220	-18			∅	-18	-50	-68	
9800N	5000E	∅			∅		-50	-50	
	4980	-8				-8		-58	
	4960	-11				-11		-61	
	4940	-8				-8		-58	
	4920	-8				-8		-58	
	4900E	-13				-13		-63	
	4880	-15				-15		-65	
	4860	-14				-14		-64	
	4840	-16				-16		-66	
	4820	-9				-9		-59	
	4800E	-19			∅	-19	-50	-69	

Additional comments:

SELF POTENTIAL DATA

PROJECT: Silver Queen

Page 2

COMMENTS:

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
9800N	4780E	-18	∅			-18	-50	-68	
10000N	5000E	/	∅		-5	-5	-50	-55	
	5020	+5				0		-50	
	5040	-4				-9		-59	
	5060	-10				-15		-65	
	5080	-10				-15		-65	
	5100E	-8				-13		-63	
	5120	-8				-13		-63	
	5140	-17				-22		-72	
	5160	-7				-12		-62	
	5180	-2				-7		-57	
	5200E	-1				-4		-54	
10000N	5220	+3	∅		-5	-2	-50	-52	
10,000N	5000E	/	∅		-5	-5	-50	-55	
	4980	-3				-8	-50	-58	
	4960	-10				-15		-65	
	4940	-12				-17		-67	
	4920	+3				-2		-52	
	4900E	+5				∅		-50	
	4880	+4				-1		-51	
	4860	-14				-19		-69	
	4840	-6				-11		-61	
	4820	-8				-13		-63	
	4800E	-5				-10		-60	
10000N	4780	-6	∅		-5	-11	-50	-61	
9950N	5000E	/	∅		-14	-14	-50	-64	
	5020	~~+5~~ -16				-30		-80	
	5040	~~+4~~ +5				-9		-59	
	5060	~~+4~~ ∅				-14		-64	
	5080	~~+7~~ -9				-23		-73	
	5100E	~~+3~~ -1				-15		-65	
	5120	~~-3~~ -5				-19		-69	
	5140	~~+5~~ -9				-23		-73	
	5160	~~-1~~ +5				-9		-59	
	5180	~~-2~~ +3				-11		-61	
	5200E	-1				-15		-65	
9350N	5220	-5	∅		-14	-19	-50	-69	

Additional comments:

SELF POTENTIAL DATA

PROJECT: Silver Queen

COMMENTS:

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
9950N	5000E	—	ϕ		-14	-14	-50	-64	
	4980	+5				-9		-59	
	4960	+4				-10		-60	
	4940	+4				-10		-60	
	4920	+2				-12		-62	
	4900E	+3				-11		-61	
	4880	-3				-17		~~57~~ -67	
	4860	+5				-9		-59	
	4840	-1				-15		-65	
	4820	-2				-17		-67	
	4800E	-5				-19		-69	
9950N	4780E	-8	ϕ		-14	-22	-50	-72	
9900N	5000E	—	ϕ		-6	-6	-50	-56	
	5020	-13				-19		-69	
	5040	-7				-13		-63	
	5060	-9				-15		-65	
	5080	ϕ				-6		-56	
	5100E	+1				-5		-55	
	5120	-9				-15		-65	
	5140	-6				-12		-62	
	5160	-9				-15		-65	
	5180	+6				ϕ		-50	
	5200E	-2				-8		-58	
9900N	5220E	-6	ϕ		-6	-12	-50	-62	
9900N	5000E	—			-6	-6	-50	-56	
	4980	-4				-10		-60	
	4960	+3				-3		-53	
	4940	-3				-9		-59	
	4920	-1				-7		-57	
	4900E	+3				-3		-53	
	4880	+4				-2		-52	
	4860	-5				-11		-61	
	4840	-8				-14		-64	
	4820	-4				-10		-60	
	4800E	-5				-11		-61	
	4780E	-8			-6	-14	-50	-64	

Additional comments:

SELF POTENTIAL DATA

PROJECT: Silver Queen

Page 4

COMMENTS:

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
9850N	5000E	—	∅		-13	-13	-50	-63	
	5020	-15				-28		-78	
	5040	-11				-24		-74	
	5060	-5				-18		-68	
	5080	+2				-11		-61	
	5100E	+3				-10		-60	
	5120	-10				-23		-73	
	5140	-17				-30		-80	
	5160	-14				-27		-77	
	5180	-10				-23		-73	
	5200E	-11				-24		-74	
9850N	5220E	-9	∅		-13	-22	-50	-72	
9850N	5000E	—	∅		-13	-13	-50	-63	
	4980	+7				-6		-56	
	4960	+17				+4		-46	
	4940	-14				-27		-77	
	4920	-4				-17		-67	
	4900E	-7				-20		-70	
	4880	-15				-28		-78	
	4860	-14				-27		-77	
	4840	-12				-25		-75	
	4820	-19				-32		-82	
	4800E	-27				-40		-90	
9850	4780E	-22	∅		-13	-35	-50	-85	
9350N	5000E	∅	∅		0		-50	-50	STAND "ALONE" LINE
	5020	+9				+9		-41	
	5040	+10				+10		-40	
	5060	-3				-3		-53	
	5080	-7				-7		-57	
	5100E	-6				-6		-56	
	5120	+2				+2		-48	
	5140	-1				-1		-51	
	5160	+5				+5		-45	
	5180	-7				-7		-57	
	5200E	-2				-2		-52	
9350N	5220	-3	∅		∅	-3	-50	-53	

Additional comments:
Line 9350N - not tied to Base Sta. at this time.
Line extended from baseline across recent trench with two "spur" lines (see map of grid.)

SELF POTENTIAL DATA

PROJECT: SILVER QUEEN

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COMMENTS: "SPUR" LINES FROM 9350N 5000E

Line	Station	Reading mV	Pot corr.	Corr. Value	Base St Value	Corr. Value	Normalizer Value	Final Value (plot)	Comments
L-9350N	5000E	∅	∅		∅		-50	-50	BASE LINE STATION
	5140	-1				-1		-51	DIVERGE STN
	5150A	+2				+2		-48	BRG 020°
	5160	+5				+5		-45	
	5170	+9				+9		-41	
	5180	+5				+5		-45	
	5200A	-1				-1		-51	
	5210	+25				+25		-25	
	5220	+3				+3		-47	
	5230	-1				-1		-51	
	5240A	-4	∅		∅	-4	-50	-54	
9350N	5140	-1	∅		∅	-1	-50	-51	
	5150B	∅				∅		-50	BRG 080°
	60	+2				+2		-48	
	70	-29				-29		-79	unstable rdg to -17
	80	+2				+2		-48	
	90	+5				+5		-45	
	5200B	-5				-5		-50	
	10	-6				-6		-56	
	20	+4				+4		-46	
	30	-4				-4		-54	
	40	-3				-3		-53	
	5250B	+6	∅		∅	+6	-50	-44	

Additional comments:
STN 9350N 5170E (B) - unstable reading may be buried metal from old mining activity