Report on a Helicopter-Borne Magnetic and Radiometric Survey

Aeroquest Job # 11-039

For

Silver Quest Resources Ltd.

by

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Report date: August 2011

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1. INTRODUCTION

This report describes a helicopter-borne geophysical survey carried out on behalf of Silver Quest Resources Ltd. on their Property in Yukon, Canada. The principal geophysical sensor was a helicopter stinger mounted caesium vapor magnetometer. The secondary sensor was Aeroquest's Airborne Gamma Ray Spectrometer (AGRS) system, which is installed in the helicopter cabin. The AGRS system utilizes four (4) downward looking NaI crystals used as the main gamma-ray sensors and one upward looking crystal for monitoring non-geologic sources. Ancillary equipment included a GPS navigation system, radar altimeter, digital video acquisition system, and a base station magnetometer.

The total survey coverage is 3410 km, of which 3274 line-km fell within the defined Boulevard project area (Appendix 1), flown in 35/215 degrees of heading line direction. Survey flying described in this report took place on July 8th to July 16th, 2011. This report describes the survey logistics, the data processing, presentation, and provides the specifications of the survey.

2. SURVEY AREA

The project contains Boulevard surveyed block located approximately 330km northwest of Whitehorse, Yukon (Figure 1). The detail description of Boulevard block with line direction has been described in the table 1.

The survey block corner-coordinates are tabulated in Appendix 1. The base of survey operations was Boulevard camp in Yukon.

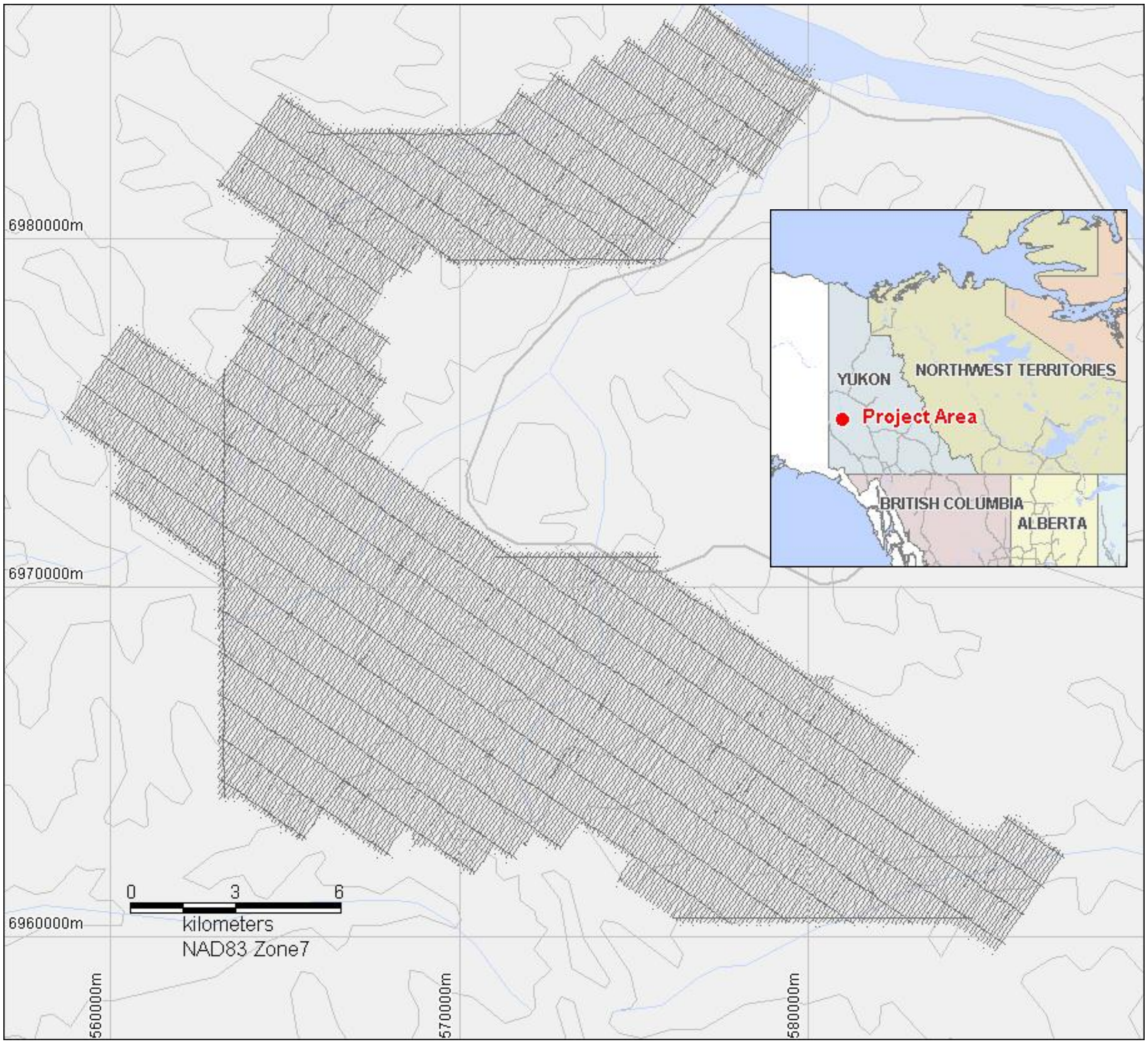

Figure 1. Boulevard Survey block overview

3. SURVEY SPECIFICATIONS AND PROCEDURES

The survey specifications are summarised in the following table:

Block name	Line Spacing (metres)	Line Direction	Tie Line Spacing (metres)	Tie Line Direction	Survey Coverage (line-km)	Dates flown
Boulevard	100	35°/215°	1000	125°/305°	3410	July 08th to July 16th, 2011

Table 1. Survey specifications summary

The survey coverage was calculated by adding up the survey and control (tie) line lengths as presented in the final Geosoft database.

The nominal helicopter stinger terrain clearance was 30 m but was periodically higher or lower over due to the rugged terrain and the capability of the aircraft. The scan rate of the helicopter stinger data acquisition was 0.10 seconds.

4. AIRCRAFT AND EQUIPMENT

This section provides a brief description of the geophysical and auxiliary instruments used to acquire the survey data:

4.1. Aircraft

An A-star 350BA helicopter – registration C-FXED was used as survey platform. The helicopter was owned and operated by Abitibi Helicopters Ltd. of Calgary, Alberta, Canada. The helicopter flew at an average airspeed of 70 knots per hour.

4.2. Magnetometer

The following magnetometer was installed inside the stinger:

Model: Geometrics G823A

Type: Airborne caesium-vapor magnetometer

Sensitivity: 0.01 nT

Sample rate: 10Hz

Magnetic Compensator:

The compensator employed was a RMS Data Acquisition & Adaptive Aeromagnetic Real-Time Compensator (DAARC500). Compensation is achieved by combining the frequency measurement from any continuous reading sensor (Cs, K, He) with the measurements of analog outputs of a tri-axial fluxgate magnetometer. A proprietary algorithm combines these measurements and eliminates most of the influence caused by airframe movement through the magnetic field – pitch, roll yaw and aircraft heading.

4.3. Magnetic Base Station

Model: Geometrics G823A

Type: portable Caesium magnetometer

Sensitivity: 0.01nT

Sample rate: 1Hz

A digital recorder is operated in conjunction with the base station magnetometer to record the diurnal variations of the earth's magnetic field. The clock of the base station is synchronized with that of the airborne system using GPS data to permit subsequent removal of diurnal drift.

4.4. Airborne Gamma Ray Spectrometer (AGRS) System

The Aeroquest AGRS system consists of an RSX-5 sensor pack, which is installed on the floor of the helicopter cabin and a DAARC500 acquisition system designed and manufactured by RMS Instruments Inc. (RMS).

The system has 4 downward looking NaI crystals (16.75 L) used as the main sensors and 1 upward looking crystal (4.18 L) for monitoring non-geologic sources. The system features automatic peak detection and real-time calibration to ensure spectrum stability and a high quality final product. The full spectrum is recorded (256 or 512 channels) to allow for subsequent noise reduction processing such as NASVD. The data are processed to produce the standard IAGA ROI channels – Total Count, Potassium, Uranium and Thorium. The dose rate, potassium percentage, equivalent uranium and thorium concentrations are also derived and ratios of these concentrations are computed to enhance the interpretation of the survey results.

4.5. Altimeters

Radar altimeter

Manufacturer:	Terra
Type:	TRA 3000 Radar Altimeter and TRI 40 Indicator
Sensitivity:	5% @200ft

Barometric altimeter

Manufacturer:	Honeywell
Type:	PPT

High Accuracy: Achieves +/0.05 Full-Scale, Including Temperature Effects over -40 to +85°C

4.6. Digital Data Acquisition System

Manufacturer:	RMS Instruments
Model:	DAARC 500 acquisition system (DAS & Adaptive Aeromagnetic Real-Time Compensator)

4.7. Video Tracking and Recording System

A wide angle Sanyo video camera was connected to Archos video recorder to provide the image. Using a video overlay board (Overland Technology Inc.) the GPS time is recorded continuously and is displayed on the margin of each image. This procedure ensures accurate correlation of digital data with respect to visible features on the ground.

4.8. GPS Navigation System

Navigation is carried out using a GPS receiver, an AGNAV GUIA system for navigation control, and DAARC500 data acquisition system which records the GPS coordinates. The x-y-z position of the aircraft, as reported by the GPS, is recorded at 0.1 second intervals. The system has a published accuracy of less than 3 metres. A recent static ground test of the Mid-Tech WAAS GPS yielded a standard deviation in x and y of less than 0.6 metres and for z less than 1.5 metres over a two-hour period.

5. PERSONNEL

The following Aeroquest personnel were involved in the project:

- Senior Project Manager: Troy Will
- Field Data Processor: Edward You
- Field Operator: Leonard Luke
- Office Data Processor: Asif Mirza / Chris Kahue
- Map Preparation and Reporting: Asif Mirza / Chris Kahue

The survey pilot, Joey Campbell was employed directly by the helicopter operator – Abitibi Helicopters Ltd.

6. DELIVERABLES

6.1. Hardcopy Deliverables

The report includes a set of 1: 50,000 scale maps of Boulevard block. The survey area is covered by one map plate for Boulevard block, and four geophysical data products are delivered as listed below:

- TMI – Coloured Total Magnetic Intensity (TMI) with contours.
- 1VG – Calculated First Vertical Derivative of TMI colour grid with contours.
- TC – Gamma Ray Spectrometer Total Counts colour grid with contours.
- Th_K_Ratio – Gamma Ray Spectrometer Thorium-Potassium Ratio colour grid with contours.

The coordinate/projection system for the Boulevard Block maps is NAD83 – UTM Zone 07N. For reference, the latitude and longitude in WGS84 are noted on the maps.

6.2. Digital Deliverables

6.3. Final Database of Survey Data (.GDB)

The geophysical profile data is archived digitally in Geosoft GDB binary database format. A description of the contents of the individual channels in the database can be found in Appendix 2.

6.4. Geosoft Grid files (.GRD)

Levelled Grid products used to generate the geophysical map images.

6.5. Digital Versions of Final Maps (.MAP, .PDF)

Map files in Geosoft .map and Adobe PDF format.

6.5.1. Free Viewing Software

- Geosoft Oasis Montaj Viewing Software
- Adobe Acrobat Reader

6.5.2. Digital Copy of this Document (.PDF)

7. DATA PROCESSING AND PRESENTATION

7.1. Base Map

The geophysical maps accompanying this report are based on positioning in the NAD83 datum. The survey geodetic GPS positions have been projected using the Universal Transverse Mercator projection in Zone 07 North. A summary of the map datum and projection specifications is given following:

- Ellipse: Clarke 1866
- Ellipse major axis: 6378206.4
- Inverse Flattening: 294.9787
- Datum: NAD83
- Map Projection: Universal Transverse Mercator Zone 07 North
- Central Scale Factor: 0.9996
- False Easting, Northing: 500,000m, 0m

For reference, the latitude and longitude in WGS84 are noted on the maps.

7.2. Radiometric Data

7.2.1. Equipment and General Adherence to IAEA Standards

Aeroquest Limited generally adopts the standards for airborne gamma-ray spectrometry (the radiometric method) as laid out in the IAEA Technical Report 323 – Airborne Gamma-Ray Spectrometry Surveying.

7.2.2. Spectral Calibration

When calibrated (with thorium source about once a year) linearity of the each detector is measured and linearity correction coefficients are calculated. When operating in real time (collecting data), the linearity of each detector is mathematically corrected for each measurement. Individual detector tracking (tuning) and linearity correction provide better fit of the individual spectra that are being summed and therefore a sharper (better resolution) spectrum is obtained.

Calibration of the 5 detectors was carried out on March 08th, 2011 as follows:

Crystal	S/N	Cs resolution (%)
1	5517UA	6.83
2	5517UB	7.06
3	5517UC	7.52
4	5517UD	6.99
5	5517DE	7.82

Results from Calibration Pad Test

Calibrations were performed by RSI at their Mississauga facility on March 08th, 2011.

Stripping Ratios	Spectrometer Unit	Ideal Values
Th into U (alpha)	0.276	0.250
Th into K (beta)	0.392	0.400
U into K (gamma)	0.765	0.810
U into Th (a)	0.045	0.060

7.2.3. Data Quality Assurance and Control

The spectrometer data are referenced to the other ancillary data sets using the RSI data acquisition system. After each flight, preliminary ROI channels are generated and profiles are then plotted from the digital data to check for any missing data, spikes or data corrupted by other noise sources. Where necessary, the data are corrected or flagged for re-flight depending on the severity or duration of the noise.

7.2.4. Live-time Correction

Generally, the radiometric data is acquired in units measured in counts per second. The instrumentation may require some time each second to process the incoming data, during this time period no counts are made. This time referred as Dead-time. Alternatively, some systems record the time during which the crystal is actually 'on' in which case the resulting value referred to as the live-time. The data was corrected by using Live-Time channels from the RSI spec pack.

$$N = n*10^{-3}/lt$$

Where:

N = Corrected counts in each second

n = raw recorded counts in each second

lt = equipment live time

7.2.5. Filtering to Prepare for Background Corrections

The radar altimeter data are filtered (low pass 5 fiducial) in order to ensure that no noise sources from the altimeter data are introduced to the radiometric data processing. The upward looking data are also filtered to improve the count statistics. In order to establish radon background levels from the upward-looking detector data, temporary heavily filtered (31 points mean filter) downward looking uranium and downward looking thorium data are utilized. The original unfiltered data are, of course, retained.

7.2.6. Cosmic and Aircraft Background

Cosmic and aircraft background expressions are determined for each spectral window as described in chapter 4 of the IAEA Technical Report 323. The general form of these expressions is N = a + bC, where N is the combined cosmic and aircraft background for each window; a is the aircraft background in the window; C is the cosmic channel count; and b is the cosmic stripping factor for the window.

The expressions are evaluated for each ROI window for each sample and used as a subtractive correction for the data.

7.2.7. Radon Background

Correction of the data for variations in background due to radon is a multi-step process. First, test flights at various elevations over water are carried out in the field to establish the contribution of atmospheric radon to the ROI windows. A least squares analysis of the data from these test flights yields the constants for equations 4.9 to 4.12 (IAEA Report 323). Second, the response of the upward looking detector to radiation from the ground is established. Here a departure from the IAEA Report has been recommended by Grasty and Hovgaard (1996). The expression for the radon component in the downward looking uranium window is given by Ur =(u – a1U – a2T + a2bT – bu)/(au – a1 – a2aT) (see Eq. 4.3 – IAEA 323) where, Ur is the radon background detected in the downward U window; u is the measured count in the upward uranium window; U is the measured count in the downward uranium window; T is the measured count in the downward thorium window; a1, a2, au and aT are proportionality factors; and bu and bT are constants determined experimentally. Using a1 or a2 (see above) in this equation will result in a good estimate of Ur permitting correction of the other ROI windows.

Survey altitude test data will be collected and used to establish atmospheric background and calibrate the upward and downward looking detector systems. Variations in count rates due to soil moisture content and altimeter variations can largely be overcome by a normalization procedure using the thorium count. The procedure correlates the thorium count to the uranium count assuming the contribution to each ROI from the ground is proportional.

7.2.8. Computation of Effective Height above Ground Level

Radar altimeter data are used in adjusting the stripping ratios for altitude and to carry out the height attenuation corrections. They are then converted to effective height (he) at STP by the expression he = (h * 273.15)/(T + 273.15)* (P/1013), where h is the observed radar altitude; T is the temperature in degrees C; and P is the barometric pressure in mbars

7.2.9. Compton Stripping Correction

The stripping ratios α, β, γ, a, b and g are determined during tests over calibration pads. The principal ratios a, β and g should be adjusted for temperature, pressure and altitude (above ground) before stripping is carried out. These stripping ratios are used to remove the contribution in each of the three ROI windows from higher energy sources, leaving only the contribution from potassium, uranium and thorium.

7.2.10. Altitude Attenuation Correction

The altitude attenuation correction corrects the data in each of the ROI windows for the effects of altitude. The count rates decrease exponentially with altitude and therefore the counts are corrected to a constant altimeter datum at the nominal survey height of 30m.

7.2.11. Apparent Radioelement Concentrations

The corrected count rate data can be converted to estimate the ground concentrations of each of the three radioelements, potassium, uranium and thorium. The procedure assumes an infinite horizontal slab source geometry with a uniform radioelement concentration. The calculation assumes radioactive equilibrium in the U and Th decay series. Therefore the U and Th concentrations are assigned as equivalent concentrations using the nomenclature eU and eTh.

An estimate of the air absorbed dose rate can be made from the apparent concentrations, K%, eU ppm and eTh ppm using the following formula:

$$E = 13.08 * K + 5.43 * eU + 2.69 * eTh$$

where: E is the absorption dose rate in nG/h
K is the concentration of potassium (%)
eU is the equivalent concentration of uranium (ppm)
eTh is the equivalent concentration of thorium (ppm)

A description of how most of the constants were determined can be found in: Exploranium, I.A.E.A. Report, Airborne Gamma-Ray Spectrometer Surveying, Technical Report No. 323, 1991.

7.2.12. Computation of Radioelement Ratios

Standard ratioing of the three radioelements (eU/eTh, eU/K and eTh/K) can be carried out and presented in profile or plan map form. In order to ensure statistical confidence in generating these ratios, we generally take the following precautions:

- Reject all data point where the apparent potassium concentration is less than 0.25% as these measurements are likely taken over water.
- Carry out cumulative summing along the survey line of each radioelement, rejecting areas where the summation does not exceed a certain threshold value (usually 10 counts for both numerator and denominator).
- Compute the ratios using the cumulative sums.

7.3. Magnetic Compensation test

Test lines were flown to check the real time magnetic compensation, in four cardinal directions corresponding to the survey line direction. The compensation test was carried out near Prospector Mountain Camp, Yukon to ensure the sensor was completely removed of ground effect.

7.4. Total Field Magnetics

The total field aeromagnetic data are corrected for the diurnal variation, by subtracting the base station magnetic data (low pass filtered to remove spikes due to cultural interference). Then the line data was corrected for heading and any remaining small levelling errors. The geophysical data are interpolated onto a regular grid using bi-directional interpolation technique. The gridded data was micro-levelled to remove small amplitude, in between flight line, levelling errors. The resulting grid is suitable for generating contour maps of excellent quality.

APPENDIX 1: SURVEY BOUNDARIES

The following table presents the project block boundaries. All geophysical data presented in this report have been windowed to 100m outside these outlines.

X and Y positions are in NAD83 UTM Zone 07N.

Boulevard Block

X		Y		X		Y
560502.4		6977431.5		584153.6		6960470.7
562973.8		6975683.8		576381.9		6960495.1
564104.7		6977314.3		575067.9		6962236.2
567288.9		6975076.5		573386.7		6963390
566755.5		6974292.1		572816.8		6962582.2
566743.3		6973114.6		572090.1		6963049.4
567217.1		6973115.0		571496.7		6962258.2
567233.2		6972730.2		570897.9		6962663.7
567980.4		6972202.8		570327.6		6961876.7
568589.9		6972202.5		569152.8		6962686.5
568584.7		6971774.2		568746.6		6962691.3
569771.5		6970928.1		568738.6		6962994.4
575619.6		6970922.8		568491.2		6963165.6
575594.2		6970508.1		567955.2		6962367.1
580025.1		6967405.9		566101.3		6963620.8
580624.4		6967387.4		565548.7		6962825.8
580621.0		6966991.8		563713.4		6964060.2
583032.9		6965302.6		563241.3		6964067.7
582471.7		6964486.6		563184.9		6970542.0
584544.6		6963024.4		560814.0		6972192.6
585396.1		6962963.8		560085.7		6972699.2
585704.6		6963418.6		560351.7		6973053.9
587280.1		6962314.2		560354.6		6973759.6
585418.8		6959676.7		558701.8		6974880.6

APPENDIX 2: DESCRIPTION OF DATABASE FIELDS

The GDB file is a Geosoft binary database. In the database, the Survey lines and Tie Lines are prefixed with an "L" for "Line" and "T" for "Tie".

Magnetic databases:

Column	Units	Description
X	m	UTM Easting (NAD83, Zone 07N)
Y	m	UTM Northing (NAD83, Zone07N)
Ralt	m	Radar Altitude
Galt	m a.s.l.	GPS Elevation
DTM	m a.s.l.	Digital Terrain Model using radar altimeter data
Lalt	m	Laser Altitude
UTCTime	HH:MM:SS.ss	UTC Time
BASEMAG	nT	Basemag value
Mag_raw	nT	Uncompensated raw magnetic data
Mag	nT	Diurnal Corrected compensated Magnetic data
Mag_heading	nT	Diurnal & Heading Corrected compensated Magnetic data
TMI	nT	Levelled Magnetic data

Radiometrics databases:

Column	Units	Description
Utc_time	hh:mm:ss.s	utc time
K_raw	Cps	Radiometrics – potassium
Th_raw	Cps	Radiometrics – Thorium
U_raw	Cps	Radiometrics – Uranium
TC_raw	Cps	Radiometrics – Total Counts
UpU_raw	Cps	Radiometrics - Uranium upward looking counts
Live Time	s	System Live Time
Ralt_stp	m	radar altitude at standard temperature and pressure
K_CPS	Cps	Radiometrics – corrected potassium
Th_CPS	Cps	Radiometrics – corrected Thorium
U_CPS	Cps	Radiometrics – corrected Uranium
TC_CPS	Cps	Radiometrics – corrected Total Counts
Cosmic_upUranium	Cps	Radiometrics - Cosmic Corrected Uranium upward looking counts
K_Percentage	%	Radiometrics – potassium (%K)
Th_ppm	ppm	Radiometrics – equivalent Thorium
U_ppm	ppm	Radiometrics – equivalent Uranium
Dose_Rate	uR/hr	Radiometrics – exposure rate
Th_K_Ratio		Thorium – Potassium Ratio
U_K_Ratio		Uranium – Potassium Ratio
U_Th_Ratio		Uranium – Thorium Ratio

Column	Units	Description
Down	counts per second	512 channel spectral data (Downward looking)
Up	counts per second	512 channel spectral data (Upward looking)
X	m	UTM Easting (NAD83, Zone 07N)
Y	m	UTM Northing (NAD83, Zone 07N)
Temperature	°C	temperature
Pressure	mbar	Barometric Pressure
Cosmic	Cps	Radiometric s– Cosmic

APPENDIX 3: RADIOMETRICS PROCESSING PARAMETERS

Aircraft Background and Cosmic Stripping Factors

COEFFICIENTS		
	Cosmic Stripping Factor (b)	Aircraft Background Value (a)
TC	1.0975	101.18
K	0.0597	12.7
U	0.0436	4.884
Th	0.0696	0.089
Uup	0.0153	0.6172

Altitude Attenuation Coefficients

COEFFICIENTS	
Element	Attenuation Coeff.
TC	-0.00532
K	-0.00618
U	-0.00512
Th	-0.00653

Sensitivity Factors

Sensitivity Factors	
Element	Sensitivity Factor at 30 m STP Height
K	64.59947 cps/%
U	7.29807 cps/ppm eU
Th	3.45573 cps/ppm eTh
Dose rate	20.81085 cps/nG/hr