Geophysical Operational Authorization Operating Licence Number:
9228-D031-001 E

DEVON CANADA CORPORATION
SAHTU GRAVITY SURVEY
FINAL REPORT
Déline, Northwest Territories
October 16 to November 17, 2005

Geographical Area: Latitude 64.5 to 65.5 degrees north
Longitude 122.7 to 125.0 degrees west

Contractor: Excel Geophysics Inc.
Box 5056
302 Center Street S
High River, Alberta, Canada T1V 1M3

Operator: Devon Canada Corporation
2000, 400 Third Avenue SW
Calgary, Alberta, Canada T2P 4H2

Interest Owners: Devon Canada Corporation, Talisman Energy

Submitted by Excel Geophysics Inc. and D.F. Yep, Devon Canada Corporation

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Images:

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Sahtu Gravity Survey Final Report

Survey

INTRODUCTION

The following report describes the gravity survey conducted by *Excel Geophysics Inc.* (*Excel*) for *Devon Canada Corporation* (*Devon*) during the fall of 2005. The Sahtu gravity survey covered an area of 7,793 km^2 in the Northwest Territories east of the Mackenzie River and west of Great Bear Lake, near Déline. The survey was conducted from October 16 through November 17, 2005. This area was mainly forested with some barren areas and was accessed and surveyed via helicopter. Figure 1 shows the location of the program.

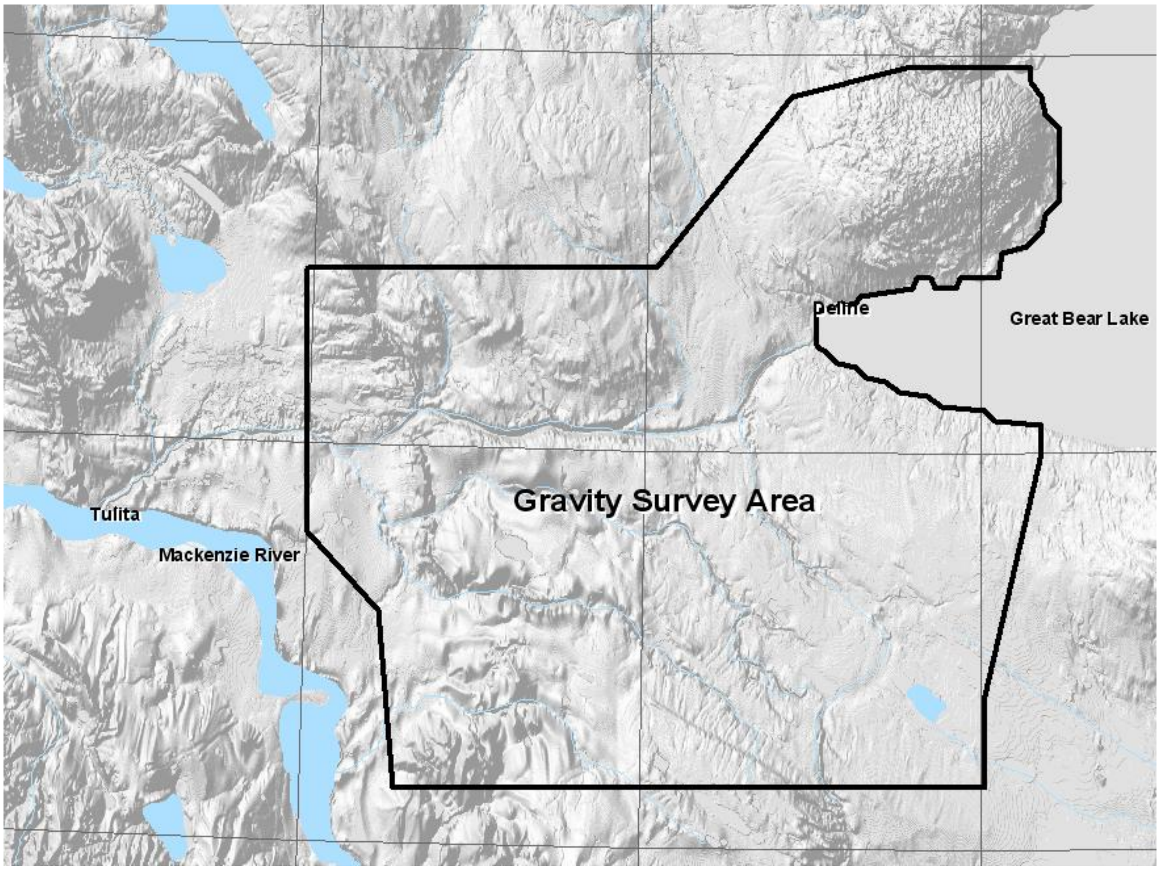

Figure 1. Sahtu survey area

SAFETY

Each crewmember held current safety certifications in Emergency First Aid, H_2S Awareness, WHMIS and Bear Awareness. An emergency response plan, containing contact numbers and emergency procedures, was distributed and explained to all field staff. Safety meetings were held by the field staff to help identify any potential safety hazards. No injuries, accidents or incidents occurred during the survey. Safety meetings and hazards were discussed with the crew on a regular basis.

Excel ensured that each member of the crew was equipped with appropriate outdoor wear, two-way radio, cellular phone, first-aid kit, and a fluorescent vest. Helicopters were maintained on a regular basis and were equipped with satellite phone, first-aid supplies, fire extinguishers, and emergency beacons.

Three helicopters were on site for the duration of the survey and had constant communication with each other in the field. In the case of an incident, there was always a second helicopter to be used for evacuation. Daily flight routes were planned in advance and a copy of this flight plan was posted in the lodge. This ensured that everyone on the crew knew the general location of the helicopters in the event of an emergency. Within the survey area, the topography was open and flat enough that there were ample landing spots available in the event of an accident requiring evacuation.

GRAVITY SURVEY PARAMETERS

The following two tables outline the main details of the gravity survey as well as the people involved with this project.

Table 1. Gravity Survey Parameters

Gravity Survey Parameters	
General Survey Location	Déline, NWT. Latitude: 64.50 degrees N to 65.50 degrees N Longitude: 125.00 degrees W to 122. 75 degrees W
Survey Duration	October 16 to November 17, 2003
Gravity Station Spacing	2,000 m
Gravity Stations Acquired	1,995
Terrain Corrections	to 40 km
Methods of Transportation	3 – Hughes 500’s, 1 – Bell 204 provided by Sahtu Helicopters
Longline Gravity Meters Used	LaCoste and Romberg U-27 (387) LaCoste and Romberg U-18 (571)
Land Gravity Meters Used	LaCoste and Romberg G-232

Table 2. Project Personnel

Project Personnel		
***Excel* Operations Manager**	Jessica Pugh	
Gravity Field Crew	Rob Folkersen	Lincoln Weller
	Sheldon Kasper	Jessica Pugh
	Mike Misanchuk	
Data Processors	Nicole Trenholm	Sheldon Kasper
***Sahtu Helicopter* Pilots**	Shanne Kochan	Jim Benbow
	Gary Martinson	Susan Colbert
	Bruce Skinner	
***Sahtu Helicopter* Engineers**	Jeff Johnston	Jeremy Giroux

GRAVITY SURVEY PROCEDURE

The survey crew consisted of four to five Excel geophysical operators/data processors, along with three pilots and one to two helicopter engineers from Sahtu Helicopters. Sahtu Helicopters conducted the longline portion of the survey as well as slung fuel from Tulita and Déline to the remote fuel caches. Excel had a supervisor on site for the duration of the project to coordinate all aspects of the operation including data quality control, client communications, aviation fuel placement, staffing, environmental compliance and adherence to safety guidelines. Operations were based out of Grey Goose Lodge located in Déline, NWT. The lodge is equipped with a dining area, sleeping accommodations, laundry facilities, and phone lines.

The entire area of exploration interest was surveyed by helicopter. A longline gravity meter was slung under the helicopter on a 150-foot longline. Figure 2 shows an example of the Hughes 500 helicopter and Figure 3 shows the longline gravity apparatus as it appeared from the air. Gravity readings were spaced at 2,000 m intervals. The DynaNav GPS navigation system was used for navigation to each gravity station using a preprogrammed set of coordinates. The precise location of the helicopter and gravity meter at each station was determined using geodetic grade Leica dual frequency GPS receivers. This aspect of the survey is described in detail under GPS survey procedure and processing.

Gravity data acquisition was conducted by the operator/processor in the helicopter using a laptop computer linked via data cable to the suspended gravity meter. The pilot was required to first lower the suspended meter to the ground, lay out a few meters of slack in the cable to eliminate helicopter vibration to the meter, and then maintain a nearby hovering position. During this hovering phase a gravity reading was acquired. On average, a gravity reading was obtained every ten minutes.

Figure 2. Example of Hughes 500 Helicopter

Figure 3. Hughes 500 helicopter and longline gravity meter on the 150-foot longline

GRAVITY BASE STATIONS

The Sahtu survey was tied to a local gravity base from the Canadian Gravity Standardization Network (CGSN). The gravity base 9186-1969 is located at the Roman Catholic Church in Déline. CGSN base 9186-1969 is shown in Figure 4. *Excel* set-up three main bases for this project; two of which were located at the Déline airport, near the helicopter landing pads for each of the longline meters, and another one located outside of the Grey Goose Lodge, for the land gravity base. The base out and base in gravity readings were recorded at the beginning and end of each day at these locations. Table 3 shows the coordinates and gravity values for all of the Déline project bases.

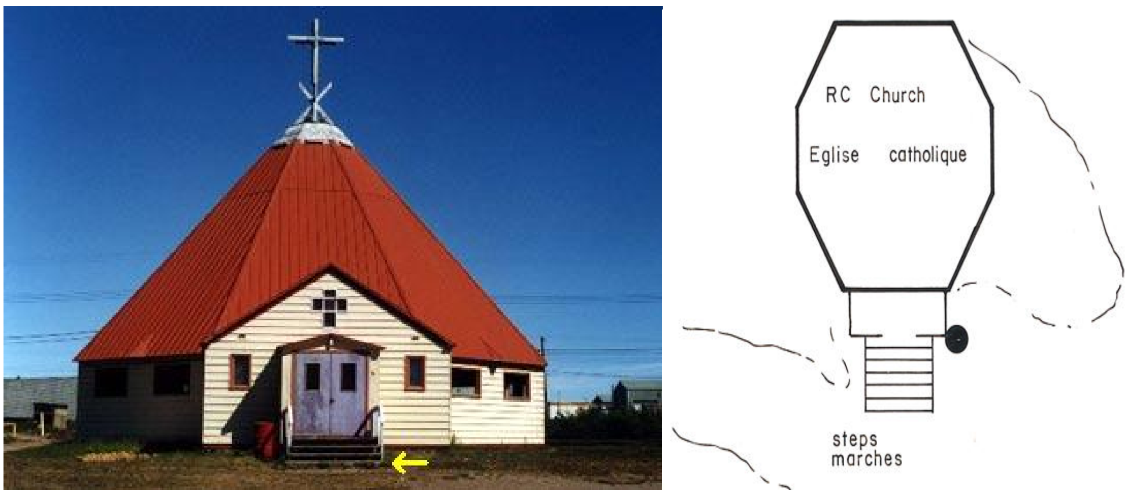

Figure 4. Gravity Base 9186-1969, Déline, NWT

Table 3. Sahtu Project Gravity Bases

Base Name	NAD 83 UTMx, m	NAD 83 UTMy, m	Observed Gravity mGal
CGSN 9186-1969; Déline	480399.98	7229663.76	982229.267
Déline Airport Longline Base 3341	479671.70	7231858.37	982221.61
Déline Airport Longline Base 3342	479682.14	7231873.07	982221.61
Grey Goose Lodge Land Gravity Base 10211	479414.76	7229835.57	982228.53

GPS SURVEY PROCEDURE AND PROCESSING

Excel established a GPS control base at the Grey Goose Lodge after solving it off a known GPS benchmark. The coordinates for both these bases are shown in Table 4. This control base at the Grey Goose Lodge was reoccupied each day in order to solve for our temporary field bases set up in the survey area, which in turn, were used as the base network to solve the data from our roving GPS units on the helicopter.

Table 4. Déline GPS Bases

Base Name	NAD 83 Latitude	NAD 83 Longitude	Ellipsoidal Elevation (m)
Benchmark 83T7000	65° 11’ 33.7834”	123° 25’ 29.8607”	163.62
Grey Goose Lodge 334 10211	65° 11’ 28.32513”	123° 26’ 22.83614”	157.37

Prior to gravity data acquisition each day, an *Excel* operator set up three or four Leica 500 series GPS receivers as temporary control bases. A helicopter was used to access suitable sites and a land gravity meter was used to obtain a reading at many of these sites. Figure 5 shows what these temporary control bases typically look like.

To ensure ample GPS coverage, the receivers were positioned so the distance to the roving unit on the helicopter was no more than eight to ten kilometers.

Figure 5. Typical temporary GPS control base

Excel's operator/processor in the longline helicopter was responsible for recording multiple instantaneous readings with the Leica 500 GPS receiver on board. Multiple readings provide better accuracy for final results. The readings were recorded only when the gravity meter was placed on the ground and the helicopter was positioned directly above the meter with the longline cable fully extended. At that position, the distance from the gravity meter to the helicopter mounted GPS antenna can be treated as a constant. This constant is calculated from the length of the longline and the position of the antenna on the helicopter.

The Leica 500 series GPS technology was chosen for longline gravity application because of its reliability, fast satellite acquisition, ease of operation, and small size. It also has advanced kinematic operational modes that are well suited to a non-stationary recording platform, such as a hovering helicopter.

GPS data were processed each evening using Leica Geosystem's post-processing software. All field bases were used to calculate solutions for the GPS rovers on the helicopter. Factors such as satellite position, signal strength and topography affect the results; the highest quality solutions were selected for each station.

GRAVITY DATA REDUCTION

The LaCoste and Romberg land gravity meter (G-series) is operated manually and is capable of reliable and repeatable gravity readings to an accuracy of 0.02 mGal by experienced operators. The operator must ensure that the meter is operated at the recommended regulated temperature and level during the reading.

The date, time, dial reading and instrument height are recorded in a field notebook at the time each reading is made. A gravity base is measured at the beginning and end of each day to correctly account for meter drift. Each evening the field data are entered into a laptop computer and corrected for sun/moon tide and instrument drift to obtain the observed gravity.

The LaCoste and Romberg longline gravity meter (U-series) works on the same principles and basic mechanics as the land gravity meter and is capable of reliable and repeatable gravity readings from the helicopter of 0.05 mGal by experienced operators. A laptop computer in the helicopter is linked to the longline meter through a data cable, enabling an operator to adjust the meter using servomotors. Temperature is monitored on the screen and leveling is done automatically. When a reading is taken the date, time, dial reading and a gravity value already corrected for sun/moon tide are written to a file. As with the land gravity meter, a gravity base station is recorded with the longline meter at the beginning and end of the day. In addition, a gravity reading is recorded at each helicopter refueling to correctly account for meter drift.

After the GPS coordinates and elevations are processed and merged with the observed gravity for each station, intermediate corrections were applied to the observed gravity to yield final Bouguer anomaly values. See Table 4 for the formulae used to determine the intermediate corrections and Bouguer gravity values. The Bouguer gravity was calculated using variable density corrections.

Table 5. Gravity Correction Formulae

Gravity Corrections	Description
Latitude Correction	Standard latitude correction adopted by the International Association of Geodesy, 1967. G=978031.85 * (1+0.005278895 $\sin^2$(latitude) + 0.000023462 $\sin^4$(latitude))
Free Air Correction	(elevation (m) – datum (m)) * 0.3068 mGal/m
Bouguer Correction	- (elevation (m) – datum (m))* density (g/cm^3) * (2.0 * pi * 0.006672) (note: density values vary depending on surface geology)
Terrain Corrections	Terrain corrections (2m to 40km) with variable densities computed with proprietary software.
Final Bouguer Values	Bouguer anomaly (mGal) = observed gravity – latitude correction + free air correction + Bouguer correction + terrain corrections

The elevation datum used in this survey was sea level.
Gravity correction units are in mGal.

DATA QUALITY

The gravity survey was of excellent quality. A critical examination of the residual gravity maps reveals that the survey is clearly within an error envelope of 0.05 mGal. Single point anomalies on the smallest residual map are likely caused by near surface gravity anomalies that are aliased due to the relatively sparse grid spacing of 2 km.

WILDLIFE

The Sahtu area is habitat for an abundant variety of animals. Each morning Chris Yukon, the wildlife monitor, went out with the base station helicopter to look for wildlife, assess fuel cache locations, and identify any heritage sites or other areas that the field crew should avoid. There was initial concern about migrating Blue-nosed Caribou moving into the survey area. However, the large Caribou herds were not seen during this project and did not interrupt the survey. When wildlife was sighted, the gravity station was skidded to avoid interaction. At the completion of the survey, no environmental damage had been done and no trace of our presence remained. Appendix B gives a detailed listing of the wildlife sightings during this survey.

SUMMARY

No incidents or accidents occurred on this project. The survey was conducted in a timely manner and completed on schedule. There was little to no negative impact to the wildlife in the area. This was a successful survey as we achieved very accurate results in a rugged and inaccessible region.

APPENDIX A - UTM Zone 10 Coordinate System Parameters

The coordinate system used for mapping purposes is UTM Zone 10 (NAD 83). Parameters for the WGS 84 ellipsoidal coordinate system with NAD 83 grid projection are shown in Table 6.

Table 6. UTM Zone 10 Mapping Parameters

Project Mapping System	
Datum	NAD 83
Ellipsoid	WGS 84
Latitude of Origin	Equator, 0º
Central Meridian	123º W
Grid Projection	UTM Zone 10
Scale Factor	0.9996
False Easting	500,000.0 m
False Northing	0.0 m

Ellipsoids:	WGS 84
Semi-major axis	6378137.0 m
Semi-minor axis	6356752.3 m

APPENDIX B – Wildlife Sightings

Date	Approximate Location		Type of Animal	Number
	UTM	UTM		Of
	(x)	(y)		Animals
(mm/dd/yy)				
10/23/05	479701	7232205	Wolf	1
10/24/05			Sharp Tail Grouse	4
10/25/05	465939	7229951	Moose with Calf	2
10/29/05	440036	7210008	Moose with Calf	2
10/29/05	431954	7209964	Bull Moose	1
10/29/05	450015	7210027	Wolf	1
10/30/05	438089	7210035	Wolf Pack	8
10/31/05	407959	7218095	Moose	6
11/01/05	439983	7228109	Caribou	7
11/01/05	433867	7213994	Caribou	9
11/02/05	476023	7223964	Silver Fox	1
11/04/05	447918	7192095	Sharp Tail Grouse	2
11/07/05	423822	7186138	Moose	3
11/07/05	420981	7211421	Bull Moose	1
11/07/05	425881	7186143	Moose	2
11/07/05	439981	7186107	Moose	3
11/07/05	445047	7213350	Caribou	1
11/07/05	475037	7219244	Bull Moose	1
11/08/05	425960	7172003	Moose	7
11/08/05	437982	7179992	Moose	1
11/08/05	417945	7183981	Moose	2
11/08/05	428230	7161992	Moose	1
11/08/05	417945	7183981	Moose	2
11/08/05	421918	7173908	Moose	1
11/11/05	437982	7183999	Moose	3

Project #	Week Start Date	Week End Date	Production Stations per week	Total Stations to date
334	21-Oct-05	23-Oct-05	183	183
	24-Oct-05	30-Oct-05	574	757
	31-Oct-05	6-Nov-05	663	1420
	7-Nov-05	13-Nov-05	540	1960
	13-Nov-05	14-Nov-05	35	1995