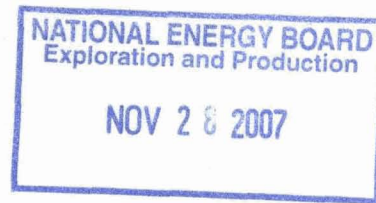


FILE COPY

N E B COPY



**Final Report**

**HUSKY SUMMIT CREEK AIRBORNE GRAVITY  
PROGRAM 2006  
NORTHWEST TERRITORIES**

**HUSKY OIL OPERATIONS LIMITED  
N.E.B. Authorization # 9222-H109-001E**



**Final Report**

**HUSKY SUMMIT CREEK AIRBORNE GRAVITY  
PROGRAM 2006  
NORTHWEST TERRITORIES**

**HUSKY OIL OPERATIONS LIMITED  
N.E.B. Authorization # 9222-H109-001E**

## **TABLE OF CONTENTS**

TABLE OF CONTENTS.....	2
ENCLOSURES.....	3
1. INTRODUCTION.....	4
2. LOGISTICS & SUMMARY .....	5
3. SAFETY, HEALTH & ENVIRONMENT .....	6
4. CONTRACTORS.....	7
5. RECORDING OPERATIONS.....	8
6. RECORDING PARAMETERS.....	9
7. RECORDING PRODUCTION SUMMARY.....	11
8. PERSONNEL .....	21
9. EQUIPMENT .....	22
10. GRAVITY PROCESSING .....	24
11. GRAVITY INTERPRETATION.....	27

## Table of Contents

1. Gravity to Seismic Comparison slides
2. DVD
  - a. TIF images of:
    - i. Maps
      1. 3<sup>rd</sup> Order Polynomial Residual Gravity map - 3rdorderpolynresidual.tif
      2. Bouger Gravity map - bouger\_367\_3km.tif
      3. Calculated Vertical Gradient map - vertical\_gradient.tif
      4. Gravity Flightpath map - flightlines.tif
    - ii. Seismic Lines with Gravity horizon:
      1. H06-256
      2. H06-263
      3. H06-268
      4. H-312
      5. J99YN293
  - b. GeoTiff images referenced in NAD 83 Zone 10:
    - i. 3<sup>rd</sup> Order Polynomial Residual Gravity map - 3rdpolyresid\_geo.tif
    - ii. Bouger Gravity map - h03-367-bug.NEB\_geo.tif
    - iii. Calculated Vertical Gradient map - calc\_vertical\_gradient\_geo.tif
    - iv. Gravity Flightpath map - h01-flightpath\_NEB\_geo.tif
  - c. GIF images of:
    - i. Top Devonian Carbonate time structure with 3<sup>rd</sup> Order Polynomial Residual Gravity contours - gravontpcarb.gif
    - ii. SubCretaceous Unconformity Time Structure with 3<sup>rd</sup> Order Polynomial Residual Gravity contours - gravonsubcret.gif
    - iii. Upper Little Bear Time Structure with 3<sup>rd</sup> Order Polynomial Residual Gravity contours - gravonultlbear.gif
  - d. 2005/06 Gravity Program corners in NAD 83 Zone 10-0506\_gravity\_outlines.xyz
  - e. Gravity to Seismic correlation Power Point file
3. Maps
  - a. 3<sup>rd</sup> Order Polynomial Residual Gravity map
  - b. Bouger Gravity map
  - c. Calculated Vertical Gradient map
  - d. Gravity Flightpath map
  - e. Top Devonian Carbonate time structure with 3<sup>rd</sup> Order Polynomial Residual Gravity contours
  - f. SubCretaceous Unconformity Time Structure with 3<sup>rd</sup> Order Polynomial Residual Gravity contours
  - g. Upper Little Bear Time Structure with 3<sup>rd</sup> Order Polynomial Residual Gravity contours
4. Seismic Lines with Gravity horizon:
  - a. H06-256
  - b. H06-263
  - c. H06-268
  - d. H-312
  - e. J99YN293

## **ENCLOSURES**

FIGURE 1 PROJECT MAP

FIGURE 2 BOUGUER CORRECTED ( $2.3 \text{ g/CM}^3$ ) GRAVITY MAP

FIGURE 3 BOUGUER CORRECTED ( $2.67 \text{ g/CM}^3$ ) GRAVITY MAP

FIGURE 4 FLIGHTPATH MAP

# 1. INTRODUCTION

Sander Geophysics Limited (SGL) conducted a high-definition aero-gravity survey for Husky Energy Inc. in the Keele River Foothills/Plain Area of the Northwest Territories. *Figure 1* shows the geographical position of the survey area. The survey was flown from October 15, 2006 to December 18, 2006. The total size of the survey was 11,391 line kilometres. A total of 34 production flights with one outing of reflights were performed using a Eurocopter AS-350 B3, registration C-GSGH. The survey operations were conducted from Tulita Airport (CZFN).

The traverse lines were flown at 600 m spacing and oriented at  $45^{\circ}$ . The control lines were at 2.4 km spacing and oriented at  $135^{\circ}$ . The survey was flown at a height of 150 m above the minimum drape surface which was designed taking into account the digital terrain model and the performance of the aircraft at that altitude. The target ground speed was 70 knots with an allowed maximum of 90 knots.

## 2. LOGISTICS & SUMMARY

The Keele Summit Block is situated in the West Central part of the Northwest Territories. It lies just west of the Mackenzie River, between Tate Lake and Redstone River. The survey block defines an area that extends roughly 20 to 30 km around the 2005 Husky project survey area. (See survey location map *Figure 1*). The Canyon Ranges are located in the west of the block and oriented mainly NW-SE. This portion of the block is quite rugged with heights of roughly 200 to 1200 metres above sea level. The south-eastern section is characterized by the Mackenzie River Valley which ranges from 50 to 100 metres above sea level. There are two main rivers; Keele River in the center and Redstone River crossing the survey block in an east-west fashion. There are also a few small glacial lakes scattered throughout the block.

The survey block is located within the perimeter defined by the following coordinates in Table 1:

**Table 1: Geographical Coordinates in WGS-84**

Corner	Latitude	Longitude
1	64.6672° N	126.8983° W
2	64.6360° N	126.5186° W
3	64.7854° N	126.3957° W
4	64.7892° N	125.5290° W
5	64.3868° N	124.5348° W
6	64.2553° N	124.8346° W
7	64.6200° N	125.7675° W
8	64.4596° N	126.1308° W
9	63.9001° N	125.4171° W
10	63.8902° N	124.6961° W
11	63.7385° N	125.0207° W
12	63.7565° N	125.7742° W
13	63.8243° N	125.9587° W
14	64.4418° N	126.5966° W
15	64.6371° N	126.7158° W

### **3. SAFETY, HEALTH & ENVIRONMENT**

Mr. Bob Raina & Mrs. Jenica Von Kuster of Northern Envirosearch Ltd., monitored the application of all environmental regulations on the program.

Morning safety meetings were conducted. Any incidents were recorded and reported on the weekly activity reports (see section 7) which were sent to the NEB.

## **4. CONTRACTORS**

Gravity Surveying - Sander Geophysical Limited

Fuel / Fuel Sloops - Norman Wells Petroleum

Communications - Aurora Technologies

Security - Red Dog Mountain Contracting

Quality Control - ELS Consulting

Northwright – Scheduled Flights to Tulita

Blue Berry B&B – Accommodations

## 5. RECORDING OPERATIONS

Sander Geophysical conducted the airborne gravity surveying using their proprietary gravimeter. The surveying was done using the Eurocopter AS 350 B3 C-GSGH which is modified to house all the surveying equipment. Sander averaged 450km/day and encountered 5 weather days.

<b>Total Kilometers Surveyed</b>		<b>9297</b>
<b>Number of Surveying Days</b>		<b>31 days excluding weather day</b>
<b>Kilometers Recorded per Day</b>		<b>450</b>
<b>Days Lost Due to Weather</b>		<b>5 day</b>
<b>Days Lost Due to Equipment Failure</b>		<b>none</b>

## **6. RECORDING PARAMETERS**

The traverse lines were flown at 600 m spacing and oriented at 45° and control lines at 2.4 km spacing and oriented at 135°. The survey was flown at a height of 150 m above the minimum drapage surface (a smooth flyable surface that has taken into account the adjacent digital terrain model around any given point and the desired performance of the aircraft at that altitude). The survey flying speed was 70 knots indicated air speed.

### **Geographical Coordinates in WGS-84**

1 64:26.40 N 126:10.04 W  
2 64:38.10 N 125:45.45 W  
3 64:01.41 N 124:16.07 W  
4 63:51.45 N 124:37.41 W  
5 63:52.39 N 125:27.12 W

The following parameters were recorded during the course of the survey:

- Aircraft altitude measured by the barometric altimeter at intervals of 0.25 seconds;
- Terrain clearance provided by the radar altimeter at intervals of 0.25 seconds;
- Terrain clearance provided by the laser altimeter at intervals of 0.01 seconds;
- Airborne GPS positional data: (altitude, longitude, height, time, and raw range from each satellite being tracked) recorded at intervals of 0.1 seconds;
- Ground based GPS positional data: (latitude, longitude, height, time, and raw range from each satellite being tracked) recorded at intervals of 0.1 seconds;
- Gravimeter data recorded with a 128 Hz sampling rate.

### **Survey Line Specifications**

Survey lines were flown with the following specifications:

	Line Direction	Line Spacing (m)
Traverse Lines	45°	600
Control Lines	135°	2400

## **Terrain Clearance**

The survey was flown using a pre-planned drape surface designed to guide the aircraft over the topography in a consistent manner as close to minimum clearance as possible. The drape surface was prepared using digital elevation model (DEM) data from Canadian Digital Elevation Data

<http://www.geobase.ca/geobase/en/data/cded1.html>) sampled at 3 arcseconds (approximately 90 m) and supplemented by a 25 m LIDAR grid supplied by Husky that partially covered the block. The DEM included an extension beyond the survey boundary to allow the aircraft to achieve the drape clearance before coming on line. The grid was smoothed using a climb and descent rate of 150 ft/nautical mile. This rate was chosen to create a gentle drape for the gravity system and is below the maximum climbing and descending capabilities of the survey aircraft. The minimum terrain clearance of 150 m was added to the drape surface.

## 7. RECORDING PRODUCTION SUMMARY

SGL WEEKLY PROGRESS REPORT No. 1 (Week of October 9th to October 15th, 2006)

Page 1 of 2

Block name:	Summit-Redstone AirGrav Project			Total Size of Survey:	11 391.0	km
Line spacing:	Traverse: 600m Control: 2400m			Total to Date:	0	km
Client:	Husky Oil Operations Limited			Production this Week:	0	km
Aircraft:	C-GSGH			Total Remaining:	11 391.0	km
Project Name:	Summit-Redstone Area Aerogravity Survey 2006			% Complete:	0	%
Operation Identifier:	9222-H109-001E					
Date	Day	Flight No.	Flight Time (hours)	No. Lines + No. Reflown Lines (T=Traverse Lines C=Control Lines)	Production km (+ Reflight km)	
October 9	Monday					
Geomag:	N/A					
Weather:	N/A					
Remarks:	N/A					
October 10	Tuesday					
Geomag:	N/A					
Weather:	N/A					
Remarks:	N/A					
October 11	Wednesday					
Geomag:	N/A					
Weather:	N/A					
Remarks:	N/A					
October 12	Thursday					
Geomag:	N/A					
Weather:	N/A					
Remarks:	Geophysicist Jenrené Martel arrived in Tulita.					
October 13	Friday					
Geomag:	N/A					
Weather:	Overcast					
Remarks:	Field Crew Chief Kim Hume arrived in Tulita with equipment.					
October 14	Saturday					
Geomag:	N/A					
Weather:	Snowing					
Remarks:	Setup in Tulita was started. C-GSGH was delayed in ferrying to Tulita due to poor weather.					
October 15	Sunday					
Geomag:	N/A					
Weather:	Scattered cloud.					
Remarks:	Setup in Tulita was continued. C-GSGH was delayed in ferrying to Tulita due to poor weather.					
TOTALS						

### Comments:

- Mobilization to Tulita began this week for the Summit-Redstone Airborne Gravity Survey.
- The arrival of the helicopter, C-GSGH has been delayed due to poor weather conditions.
- The weather forecast is calling for clearer weather on Monday, and the pilots are hopeful they will be able to fly.
- A safety meeting will be held when the crew arrives.

Block name:	Summit-Redstone AirGrav Project		Total Size of Survey:	11,391.0	km
Line spacing:	Traverse: 600m Control: 2400m		Total to Date:	1184.0	km
Client:	Husky Oil Operations Limited		Production this Week:	1184.0	km
Aircraft:	C-GSGH		Total Remaining:	10,207.0	km
Project Name:	Summit-Redstone Area Aerogravity Survey 2006		% Complete:	10	%
Operation Identifier:	9222-H109-001E				
Date	Day	Flight No.	Flight Time (hours)	No. Lines + No. Reflown Lines (T=Traverse Lines C=Control Lines)	Production km (+ Reflight km)
October 16	Monday				
Geomag:	N/A				
Weather:	Sunny				
Remarks:	The helicopter and pilots arrived in Tulita				
October 17	Tuesday				
Geomag:	N/A				
Weather:	Overcast				
Remarks:	Preparations continued for the start of production flying. The crew held a safety meeting.				
October 18	Wednesday				
Geomag:	N/A				
Weather:	Overcast				
Remarks:	The helicopter flew to Norman Wells for a gravity calibration.				
October 19	Thursday				
Geomag:	N/A				
Weather:	Cloudy, ice fog				
Remarks:	No flights due to poor weather. Erwin Ebner arrived in Tulita.				
October 20	Friday	001	3.1	4 T	214.6
Geomag:	Active				
Weather:	Overcast				
Remarks:	Flew a test flight along with 4 survey lines. Erwin Ebner left Tulita				
October 21	Saturday	002	4.8	8 T	407.6
Geomag:	Active				
Weather:	Overcast, high ceiling				
Remarks:	A production flight was flown.				
October 22	Sunday	003	6.2	17 T	561.8
Geomag:	Active				
Weather:	Scattered cloud.				
Remarks:	A production flight was flown.				
TOTALS			14.1	29 T	1184.0

## Comments:

- The pilots arrived with the helicopter on Monday.
- A safety meeting was held the following day.
- The helicopter flew to Norman Wells for a gravity calibration prior to the start of the survey.
- Erwin Ebner arrived in Tulita on Thursday and left the following day.
- A test flight was flown on Friday and production has started.

Block name:	Summit-Redstone AirGrav Project		Total Size of Survey:	11,391.0	km
Line spacing:	Traverse: 600m Control: 2400m		Total to Date:	3 117.7	km
Client:	Husky Oil Operations Limited		Production this Week:	1 933.7	km
Aircraft:	C-GSGH		Total Remaining:	8,273.3	km
Project Name:	Summit-Redstone Area Aerogravity Survey 2006		% Complete:	27	%
Operation Identifier:	9222-H109-001E				
Date	Day	Flight No.	Flight Time (hours)	No. Lines + No. Reflown Lines (T=Traverse Lines C=Control Lines)	Production km (+ Reflight km)
October 23	Monday				
Geomag:	N/A				
Weather:	Low clouds and fog.				
Remarks:	No flight due to poor visibility.				
October 24	Tuesday	004	7.5	2C 25T	658.2
Geomag:	Unsettled				
Weather:	High overcast				
Remarks:	Production flight.				
October 25	Wednesday	005	5.0	8T	484.8
Geomag:	Active				
Weather:	High overcast				
Remarks:	Production flight ended early due to poor weather.				
October 26	Thursday				
Geomag:	N/A				
Weather:	Low clouds and fog.				
Remarks:	No flight due to poor visibility.				
October 27	Friday	006	3.2	12T	241.8
Geomag:	Active				
Weather:	Low clouds clearing in the afternoon.				
Remarks:	Production flight in the late afternoon.				
October 28	Saturday				
Geomag:	N/A				
Weather:	Overcast				
Remarks:	Power was lost at the airport overnight due to a breaker tripping. The aircraft heaters have since been moved to a separate circuit. System was warmed up and calibrations performed.				
October 29	Sunday	007	8.6	2C 19T	548.9
Geomag:	Active				
Weather:	Overcast				
Remarks:	Production flight.				
TOTALS			24.3	4C 64T	1933.7

## Comments:

- Production flights continued this week with delays due to weather and loss of power at the airport.
- AME Simon Worswick arrived in Tulita on Wednesday.

Block name:	Summit-Redstone AirGrav Project		Total Size of Survey:		11 391.0	km
Line spacing:	Traverse: 600m Control: 2400m		Total to Date:		5890.5	km
Client:	Husky Oil Operations Limited		Production this Week:		2772.8	km
Aircraft:	C-GSGH		Total Remaining:		5500.5	km
Project Name:	Summit-Redstone Area Aerogravity Survey 2006		% Complete:		52	%
Operation Identifier:	9222-H109-001E					
Date	Day	Flight No.	Flight Time (hours)	No. Lines + No. Reflown Lines (T=Traverse Lines C=Control Lines)	Production km (+ Reflight km)	
October 30	Monday	008	6h21	16T	633.8	
Geomag:	Active					
Weather:	High overcast					
Remarks:	Full production flight					
October 31	Tuesday	009	1h30	2C	152.3	
Geomag:	Active					
Weather:	Low clouds					
Remarks:	Short production flight ended early due to poor visibility					
November 1	Wednesday	010	6h55	15T+1C	627.8	
Geomag:	Active					
Weather:	High overcast					
Remarks:	Full production flight					
November 2	Thursday		0	0	0	
Geomag:	Active					
Weather:	Low clouds and fog.					
Remarks:	No flight due to poor visibility.					
November 3	Friday	011	6h12	20T+1C	511.8	
Geomag:	Active					
Weather:	Low clouds clearing in the afternoon.					
Remarks:	Full production flight. Stefan Elieff and Mustapha Kerbali arrived in Tulita.					
November 4	Saturday	012	3h10	12T	263.1	
Geomag:	Active					
Weather:	Ice fog in the morning, Clear in the afternoon					
Remarks:	Aircraft battery issues in the morning resolved in time for an afternoon flight. Kim Hume left Tulita					
November 5	Sunday	013	7h12	18T+2C	584.0	
Geomag:	Active					
Weather:	Clear skies					
Remarks:	Full production flight					
TOTALS				81T+6C	2772.8	

## Comments:

- Very good production this week with 4 full flights, 2 partial flights and one weather day on Thursday.
- There was a minor issue with the aircraft battery on Saturday morning. The battery blanket stopped working during the night and thus the battery lost it's charge. We therefore proceeded to charge the battery and an afternoon flight was performed. The battery will now be brought back to the Bed and Breakfast after each flight to keep it warm overnight.
- Stefan Elieff and Mustapha Kerbali joined the crew on Friday afternoon.
- Kim Hume left Tulita on Saturday morning.

Block name:	Summit-Redstone AirGrav Project	Total Size of Survey:	11 391.0	km	
Line spacing:	Traverse: 600m Control: 2400m	Total to Date:	7454.4	km	
Client:	Husky Oil Operations Limited	Production this Week:	1563.9	km	
Aircraft:	C-GSGH	Total Remaining:	3936.6	km	
Project Name:	Summit-Redstone Area Aerogravity Survey 2006	% Complete:	65	%	
Operation Identifier:	9222-H109-001E				
Date	Day	Flight No.	Flight Time (hours)	No. Lines + No. Reflown Lines (T=Traverse Lines C=Control Lines)	Production km (+ Reflight km)
November 6	Monday	014+015	1h20	1T+1C	74.1
Geomag:	Quiet				
Weather:	Clear skies				
Remarks:	Two lines flown. Aircraft returned early due to gravimeter error.				
November 7	Tuesday	016	4h	5T+1C	231.1
Geomag:	Quiet				
Weather:	Fog in the morning, cloudy the rest of the day				
Remarks:	Production continued. Richard Barrette (Pilot) arrived in Tulita. Brian Simms left Tulita. Power outage throughout the town in the evening.				
November 8	Wednesday				
Geomag:	Quiet				
Weather:	High overcast				
Remarks:	Gravimeter trouble shooting and warm up after power loss. No production				
November 9	Thursday	017	3h	10T	233.5
Geomag:	Quiet				
Weather:	Snowing in the morning and clear in the afternoon				
Remarks:	Afternoon production flight				
November 10	Friday				
Geomag:	Unsettled				
Weather:	Low clouds				
Remarks:	No flight due to weather				
November 11	Saturday	018	6h30	14T+2C	499.8
Geomag:	Unsettled				
Weather:	Overcast in the morning and clear in the afternoon				
Remarks:	Full production flight				
November 12	Sunday	019	6h50	22T+1C	525.4
Geomag:	Quiet				
Weather:	Clear skies in the morning, scattered afternoon clouds.				
Remarks:	Full production flight				
TOTALS			21h40	52T+5C	1563.9

## Comments:

- Pilot Brian Simms departed and was replaced by Richard Barrette.
- Production flights continued.

Block name:	Summit-Redstone AirGrav Project		Total Size of Survey:	11 391.0 km	
Line spacing:	Traverse: 600m Control: 2400m		Total to Date:	9112.2 km	
Client:	Husky Oil Operations Limited		Production this Week:	1657.8 km	
Aircraft:	C-GSGH		Total Remaining:	2278.8 km	
Project Name:	Summit-Redstone Area Aerogravity Survey 2006		% Complete:	80 %	
Operation Identifier:	9222-H109-001E				
Date	Day	Flight No.	Flight Time (hours)	No. Lines + No. Reflown Lines (T=Traverse Lines C=Control Lines)	Production km (+ Reflight km)
November 13	Monday	020	3:50	13T	285.7
Geomag:	Quiet				
Weather:	Mostly clear, some fog				
Remarks:	Production flight in the morning and aircraft maintenance in the afternoon				
November 14	Tuesday	021	4:40	4T+4C	395.4
Geomag:	Quiet				
Weather:	Fog in the morning, cloudy the rest of the day				
Remarks:	Production continued.				
November 15	Wednesday				
Geomag:	Quiet				
Weather:	Snow				
Remarks:	No production due to weather.				
November 16	Thursday				
Geomag:	Quiet				
Weather:	Snow				
Remarks:	No production due to weather				
November 17	Friday				
Geomag:	Quiet				
Weather:	Snow				
Remarks:	No production due to weather				
November 18	Saturday	022	6:30	16T+2C	502.4
Geomag:	Quiet				
Weather:	Clear				
Remarks:	Full production flight				
November 19	Sunday	023	5:30	7T+8C	474.3
Geomag:	Quiet				
Weather:	Light snow				
Remarks:	Production ended early due to unfavourable weather				
TOTALS			20:30	40T+14C	1657.8

Comments:

- Production continued.

Block name:	Summit-Redstone AirGrav Project	Total Size of Survey:	11,391.0	km	
Line spacing:	Traverse: 600m Control: 2400m	Total to Date:	9712.68	km	
Client:	Husky Oil Operations Limited	Production this Week:	600.48	km	
Aircraft:	C-GSGH	Total Remaining:	1,678.32	km	
Project Name:	Summit-Redstone Area Aerogravity Survey 2006	% Complete:	85	%	
Operation Identifier:	9222-H109-001E				
Date	Day	Flight No.	Flight Time (hours)	No. Lines + No. Reflown Lines (T=Traverse Lines C=Control Lines)	Production km (+ Reflight km)
November 20	Monday				
Geomag:	Quiet				
Weather:	Snowing				
Remarks:	No flights due to weather				
November 21	Tuesday	024	4:40	11T+3C	448.28
Geomag:	Quiet				
Weather:	Clear				
Remarks:	Production continued				
November 22	Wednesday	025+026	3:00	3T	119.9
Geomag:	Quiet				
Weather:	Clear				
Remarks:	Both flight ended early due to instrumentation troubles				
November 23	Thursday	027	1:40	2T	32.3
Geomag:	Quiet to unsettled				
Weather:	Cloudy				
Remarks:	Flight aborted due to gravimeter error				
November 24	Friday	028	1:30	0T+0C	0
Geomag:	Quiet to unsettled				
Weather:	Snow				
Remarks:	Flight aborted due to weather				
November 25	Saturday				
Geomag:	Quiet to unsettled				
Weather:	Light snow				
Remarks:	Flight aborted due to gravimeter error. Richard, Mike and Simon gone to Norman Wells for aircraft inspection				
November 26	Sunday				
Geomag:	Quiet				
Weather:	Light snow				
Remarks:	No production. Aircraft in Norman Wells for inspection				
TOTALS			10:50	16T+3C	600.48

## Comments:

- Production continued.
- Aircraft is undergoing inspection in Norman Wells and is expected back in Tulita on Wednesday or Thursday.

Block name:	Summit-Redstone AirGrav Project		Total Size of Survey:	11,391.0	km
Line spacing:	Traverse: 600m Control: 2400m		Total to Date:	9712.68	km
Client:	Husky Oil Operations Limited		Production this Week:	0.00	km
Aircraft:	C-GSGH		Total Remaining:	1,678.32	km
Project Name:	Summit-Redstone Area Aerogravity Survey 2006		% Complete:	85	%
Operation Identifier:	9222-H109-001E				
Date	Day	Flight No.	Flight Time (hours)	No. Lines + No. Reflown Lines (T=Traverse Lines C=Control Lines)	Production km (+ Reflight km)
November 20	Monday				
Geomag:	N/A				
Weather:	Clear				
Remarks:	No Production. Aircraft undergoing inspection in Norman Wells				
November 21	Tuesday				
Geomag:	N/A				
Weather:	Clear				
Remarks:	No Production. Aircraft undergoing inspection in Norman Wells				
November 22	Wednesday				
Geomag:	N/A				
Weather:	Clear				
Remarks:	No Production. Aircraft undergoing inspection in Norman Wells				
November 23	Thursday				
Geomag:	N/A				
Weather:	Clear				
Remarks:	No Production. Aircraft undergoing inspection in Norman Wells				
November 24	Friday				
Geomag:	N/A				
Weather:	Clear				
Remarks:	No production. Aircraft in Norman Wells. Dan Geue and Mark Bylsma arrived in Norman Wells				
November 25	Saturday				
Geomag:	N/A				
Weather:	Clear				
Remarks:	No production. Equipment troubleshooting in Norman Wells				
November 26	Sunday				
Geomag:	N/A				
Weather:	Clear				
Remarks:	No production. Equipment troubleshooting in Norman Wells. Simon Worswick left Norman Wells for Ottawa				
TOTALS					

## Comments:

- The Aircraft underwent inspection in Norman Wells.
- Dan Geue and Mark Bylsma arrived in Norman Wells to troubleshoot the gravimeter.
- Simon Worswick left Norman Wells for Ottawa.

Block name:	Summit-Redstone AirGrav Project	Total Size of Survey:	11 391.0	km	
Line spacing:	Traverse: 600m Control: 2400m	Total to Date:	10114.28	km	
Client:	Husky Oil Operations Limited	Production this Week:	401.6	km	
Aircraft:	C-GSGH	Total Remaining:	1276.72	km	
Project Name:	Summit-Redstone Area Aerogravity Survey 2006	% Complete:	89	%	
Operation Identifier:	9222-H109-001E				
Date	Day	Flight No.	Flight Time (hours)	No. Lines + No. Reflown Lines (T=Traverse Lines C=Control Lines)	Production km (+ Reflight km)
November 20	Monday				
Geomag:	N/A				
Weather:	Clear				
Remarks:	Equipment troubleshooting				
November 21	Tuesday				
Geomag:	N/A				
Weather:	Variable cloudiness				
Remarks:	Equipment troubleshooting				
November 22	Wednesday				
Geomag:	N/A				
Weather:	Cloudy				
Remarks:	Equipment troubleshooting. Nathan Shirey arrived in Norman Wells.				
November 23	Thursday				
Geomag:	N/A				
Weather:	Clear				
Remarks:	Equipment troubleshooting				
November 24	Friday				
Geomag:	N/A				
Weather:	Overcast, light snow				
Remarks:	Equipment troubleshooting				
November 25	Saturday				
Geomag:	N/A				
Weather:	Mix of sun and clouds				
Remarks:	Successful test flight in Norman Wells. Ferry flight from Norman Wells to Tulita. Nathan arrived in Tulita.				
November 26	Sunday	029	5h	14T	401.6
Geomag:	Unsettled				
Weather:	Clear				
Remarks:	Production flight				
TOTALS			5h	14T	401.6

## Comments:

- Troubleshooting continued throughout the week.
- We had a successful test flight on Saturday after Dan found a loose connection on Friday.
- The pilots ferried to Tulita after the test flight and Nathan followed on the next available flight.
- Dan and Mark will stay in Norman Wells until two production flights have been completed.

Block name:	Summit-Redstone AirGrav Project	Total Size of Survey:	11,391.0	km	
Line spacing:	Traverse: 600m Control: 2400m	Total to Date:	11,391.0	km	
Client:	Husky Oil Operations Limited	Production this Week:	1,878.3	km	
Aircraft:	C-GSGH	Total Remaining:	0	km	
Project Name:	Summit-Redstone Area Aerogravity Survey 2006	% Complete:	100	%	
Operation Identifier:	9222-H109-001E				
Date	Day	Flight No.	Flight Time (hours)	No. Lines + No. Reflown Lines (T=Traverse Lines C=Control Lines)	Production km (+ Reflight km)
December 11	Monday	030	5h30	14T+2C	485.1
Geomag:	Quiet				
Weather:	Cloudy				
Remarks:	Production flight				
December 12	Tuesday	031	5h30	16T	452.4
Geomag:	Quiet to unsettled				
Weather:	Overcast, light snow				
Remarks:	Production flight				
December 13	Wednesday				
Geomag:	Quiet				
Weather:	Cloudy, snow				
Remarks:	No production due to weather.				
December 14	Thursday	032	3h30	7T+2C	276.5
Geomag:	Unsettled to active				
Weather:	Cloudy, snow				
Remarks:	Short production flight				
December 15	Friday	033	4h30	11T	330
Geomag:	Quiet to unsettled				
Weather:	Overcast, light snow				
Remarks:	Production flight				
December 16	Saturday	034	4h30	7T+4C	334.3
Geomag:	Quiet				
Weather:	Mix of sun and clouds				
Remarks:	Last Production flight				
December 17	Sunday		0.6		
Geomag:	Unsettled				
Weather:	Clear				
Remarks:	Helicopter Ferried to Norman Wells. Survey equipment packed up.				
TOTALS			24h40	45T+8C	1878.3

## Comments:

- Production continued this week with the last flight of the survey on Saturday.
- The crew began the demobilization process on Sunday.
- Helicopter Ferried to Norman Wells on Sunday.

## 8. PERSONNEL

Party Chief/Geophysicist:	Kim Hume Stefan Elieff Jenrené Martel
Geophysicist:	Mustapha Kerbali
Aircraft Mechanic:	Simon Worswick Nathan Shirey
Technician:	Dan Geue Mark Bylsma
Helicopter Pilot:	Brian Simms Richard Barrette
Helicopter Co-Pilot :	Mike Brisson

## 9. EQUIPMENT

**Husky Energy Inc.  
Keele Summit NT - 2006**

Item Name	Serial	Description	Manufacturer
<b>SGH-HELICOPTER</b>			
AirGrav Control Computer	GEER-04		SGL
AirGrav Data Acquisition	G-DAC-01		SGL
Baro Sensor	993567	model THE	Sensotec
Data acquisition computer	CPCI-03		SGL
DGPS Antenna	7025	P/N AT1665-OW-TNCF-000-RG-38-NM	AeroAntenna
DGPS Receiver	ZE355276	Model 3000LR	Omnistar
Digital camera	8353202728	Canon, Power Shot SD110, Digital Elph	Canon
Frequency Standard	2432A01345	Rubidium Vapor Frequency Standard, model 5065A	HP
GPS Antenna	512C-7519	model 512C, L1/L2	AeroAntenna
Gravimeter System	GRV G2-2	Airborne Gravimeter Platform	SGL
INMARSAT Transceiver	DCC00254AD71	Transceiver D+, P/N DMR200	Skywave Mobile
Laser Scanning Unit	9993241	model LMS-Q140-80	Riegl Inc
Monitor LCD 6.4"	S025966340014	model LS64PA30A	
Monitor LCD 6.4"	S025966340015	model LS64PA30A	
Satellite Telephone - Iridium	300003000324200	Motorola MS1-20, Satellite Series 9505	Motorola
VCR	11720496	SR-T5U, 12DC	JVC
Video Camera	619429	Model TNC4604X, Colour CCD TV Camera, 12VDC	Elmo
Aircraft C-GSGH	3748	Eurocopter AS350 B3, Engine Turbomeca, mod. Arriel 2B, S/N 22419,	Eurocopter
Computer - P4	P4-82	Desktop Computer	SGL
Frequency Standard	1418A00541	Rubidium Vapor Frequency Standard, model 5065A	HP
GPS Antenna	NRK03480021	model SK600	Sokkia
GPS Antenna	NRK04100011	model SK600	Sokkia
Ground station computer	GND-53	input 12VDC	Cyber Research Inc.
Ground station computer	GND-52	input 12VDC	Cyber Research Inc.
GSU	GSU-004	Power supply	SGL
GSU	GSU-003	Power supply	SGL
HDD - IDE 2.5"	STI-013	1GB IDE Flashdrive	Simpletech
HDD - IDE 2.5"	050825FL1-008	2GB IDE Flashdrive	Simpletech
HDD - Solid State	BPOG012492	E-Disk, model D3A11, 1024MB	BitMicro Networks
Keyboard	BAK061705023132	model 860-DP-PS/2, with HulaPoint mouse	Stealth Computer
Keyboard	BAK061705023134	model 860-DP-PS/2, with HulaPoint mouse	Stealth Computer
Monitor LCD 6.4"	S025966340013	model LS64PA30A	
Monitor LCD 6.4"	FPD64-13	model ENH064V1-600, VGA, 640x480 pixels, brightness 600	Panelview
Monitor LCD TFT 15"	S5EMU290114	model NF-1500MAE, AC/DC adapter 100-240VAC/12VDC	NFREN
Network Switch 5-port	B209335001086	model DSS-5+	D-Link
Power Distribution Box	PODB24-02	110/220 AC to 24DC	DUNN Systems
Power Distribution Box	PODB12-01	Ground - 110/220 AC to 12 DC	DUNN Systems
Power Generator	EZEJ-1020662	model EZ2500, 2.3kVA, portable, red	Honda
Printer	3KDY120083	Stylus Color 1520, model P892A, input 120V	P.T. Indonesia Epson
Radio - VHF	2101801	VHF Air Band Transceiver ICOM IC-A5	ICOM
Satellite Telephone - Iridium	300003000229490	Motorola MS1-20, Satellite Series 9505	Motorola
Uninterruptable Power Supply	JB0404020493	BX1000	APC



## GEOPHYSICAL SURVEY AIRCRAFT

# EUROCOPTER AS 350 B3

Registration: C-GSGH  
Serial # 3748

The AS 350 B3 is a modern high performance light helicopter powered by a turbomeca Arriel 2B turbine engine. It has been outfitted for low level airborne geophysical surveys. Sensors are carried either internally or externally in towed "birds" on a cable. Its endurance is between two and four hours depending on the survey configuration. Its performance and effectiveness has been proven on numerous projects in Canada, Central America, and Africa.



## 10. GRAVITY PROCESSING

### Gravity Data

Gravity data are recorded at 128 Hz. Accelerations are filtered and decimated to match GPS measurements using specially designed filters to avoid biasing the data. Gravity is calculated by subtracting the GPS derived aircraft accelerations from the inertial accelerations. In survey flying, accelerations in an aircraft can reach 0.1 G, equivalent to 100,000 mGal. Data processing must extract gravity data from this very noisy environment. This is achieved by modeling the movements of the aircraft in flight by extremely accurate GPS measurement. The calculated gravity is corrected for the Eötvös effect and normal gravity and the sample interval is reduced to 2 Hz. These operations are all performed by SGL's proprietary GRAVGPS software.

The following standard corrections were applied to the gravity data to calculate the Bouguer anomaly data:

- a) Eötvös correction,  $g_{\text{Eötvös}} = -v_x 2\cos\Phi / [(r + h)\cos\Phi] - 2 \cdot 0.00007292115\cos\Phi v_x - v_y 2/(r + h)$ , where  $\Phi$  is the latitude of the aircraft,  $v_x$  and  $v_y$  are the velocities of the aircraft in the x (north) and y (east) direction,  $r$  is the Earth's radius at the latitude  $\Phi$ , and  $h$  is the altitude of the plane above the GRS-80;
- b) Normal gravity,  $g = 9.7803267714(1 + 0.00193185138639\sin^2\Phi) / \sqrt{(1 - 0.00669437999013\sin^2\Phi)}$ , where  $\Phi$  is the latitude of the aircraft;
- c) Free air correction,  $g_{\text{fa}} = -0.3086h$ , where  $h$  is height of the aircraft in meters;
- d) Bouguer,  $g_{\text{sb}} = 2\pi\gamma\rho h = 0.041925\rho h$ , where  $\gamma$  is the Universal Gravity constant,  $\rho$  is density for this project (2.3, and 2.67 g/cm<sup>3</sup>), and  $h$  is height of the ground below the aircraft in meters;
- e) Curvature of the earth,  $g_{\text{ec}} = 1.464 h - 0.3533 h^2 + 0.000045 h^3$ , where  $h$  is height of the ground in kilometers;
- f) Terrain,  $g_t$ . See below for a description of the terrain correction technique;
- g) Static correction,  $g_{\text{sc}}$ , based on static ground recordings and repeat lines;
- h) Level correction,  $g_{\text{lc}}$ , based on line intersections.

Thus Bouguer anomaly =  $G - g_{\text{fa}} - g_{\text{sb}} - g_{\text{ec}} + g_t - g_{\text{sc}} - g_{\text{lc}}$ , where  $G$  is the calculated gravity adjusted for Eötvös effect and normal gravity.

## **Terrain Corrections**

Terrain corrections were computed using terrain derived by joining the high-resolution LIDAR grid supplied by Husky, the computed terrain from the merged radar and laser altimeter data, and Canadian Digital Elevation Data grids (<http://www.geobase.ca/geobase/en/data/cded1.html>) for coverage outside the survey area up to 160 km from the survey block for accurate regional corrections. Terrain corrections were computed using software developed for SGL by the University of Calgary Geomatics department. The algorithm calculates terrain corrections using 2D FFT methods with a constant density. The terrain and Bouguer corrections were calculated using densities of 2.3 g/cm<sup>3</sup>, and 2.67 g/cm<sup>3</sup>. Paper maps were created using the same densities.

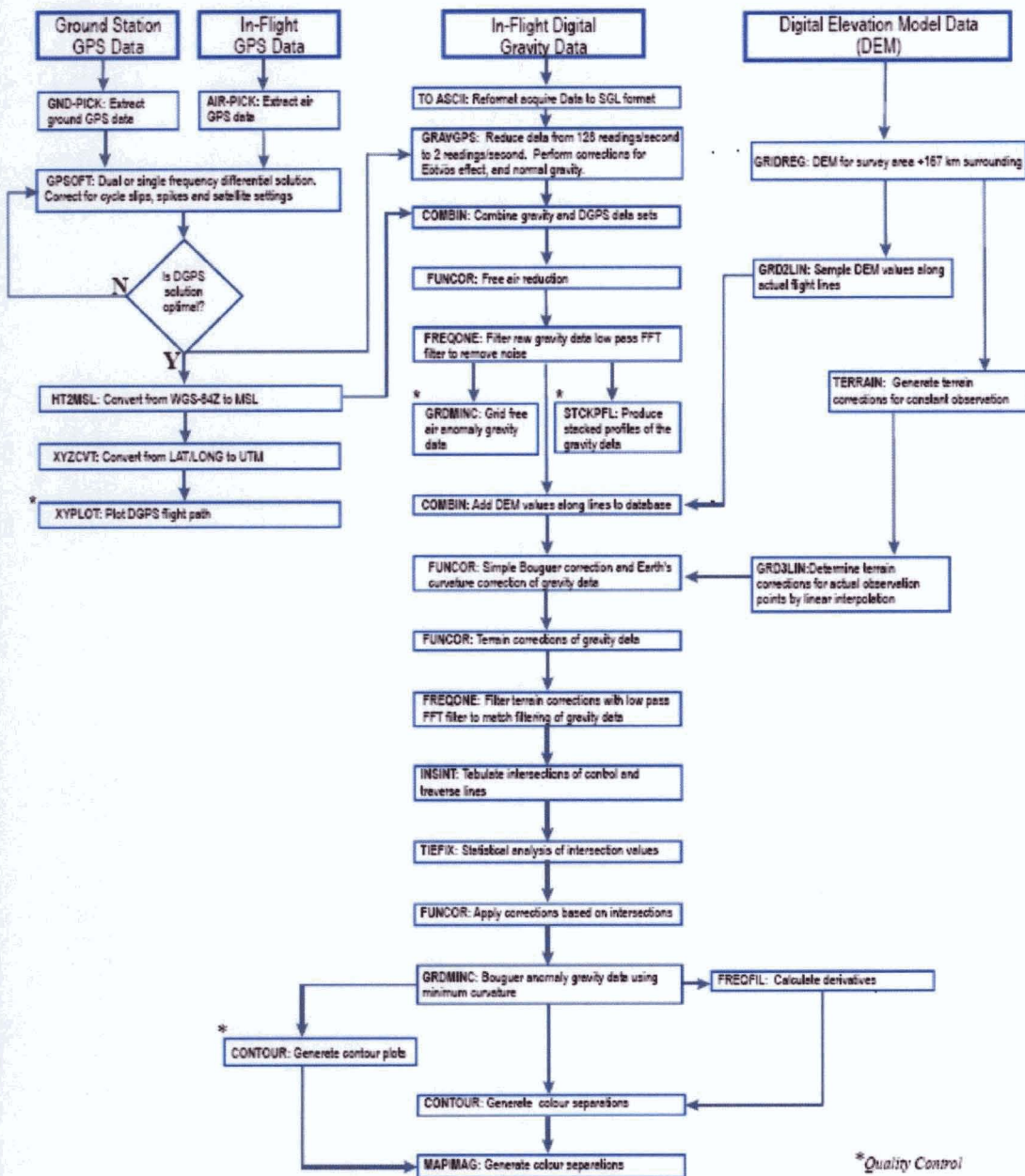
## **Leveling and Gridding**

The gravimetric data were levelled to compensate for instrument variations in two steps. A single constant shift determined from ground static recordings was applied on a flight-by-flight basis. Control line intersection statistics were then used to calculate shifts for individual lines. The AIRGrav system is very stable so the control line leveling adjustments are small, typically within +/-0.5 mGal.

Grids of the free air and Bouguer anomaly were generated by filtering the line data to remove high frequency noise, gridding using minimum curvature algorithm and filtering using a 2-d FFT based grid filter. Grids were created with both a shorter 1500 m halfwavelength filter (0% pass at 1125 m, 100% pass at 2250 m) and a longer 2000 m halfwavelength filter (0% pass at 1500 m, 100% pass at 3000 m). The First Vertical Derivatives of the Terrain Corrected Bouguer Gravity grids were calculated for verification of the terrain correction and levelling.

A gravity processing flowchart is presented below

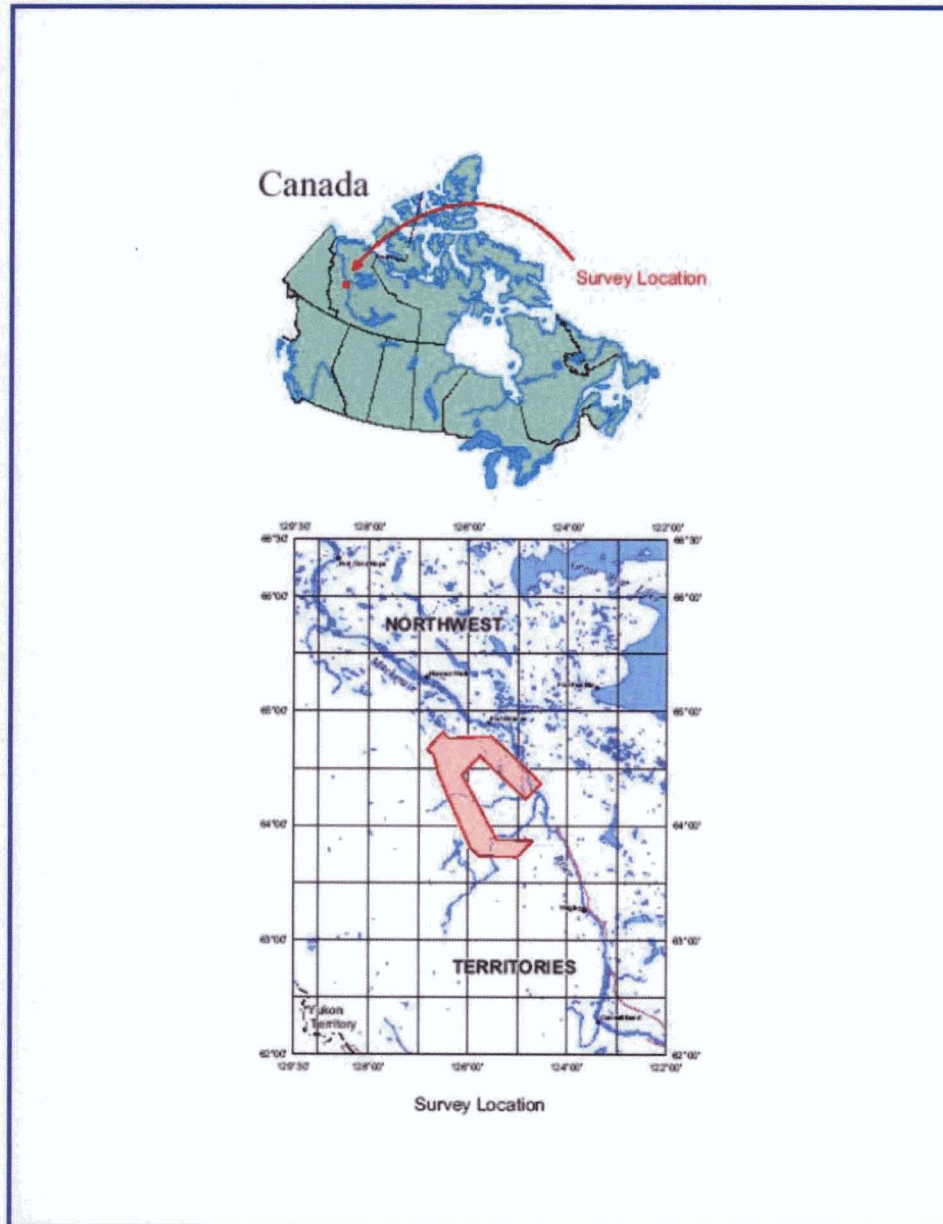
## GRAVITY DATA PROCESSING

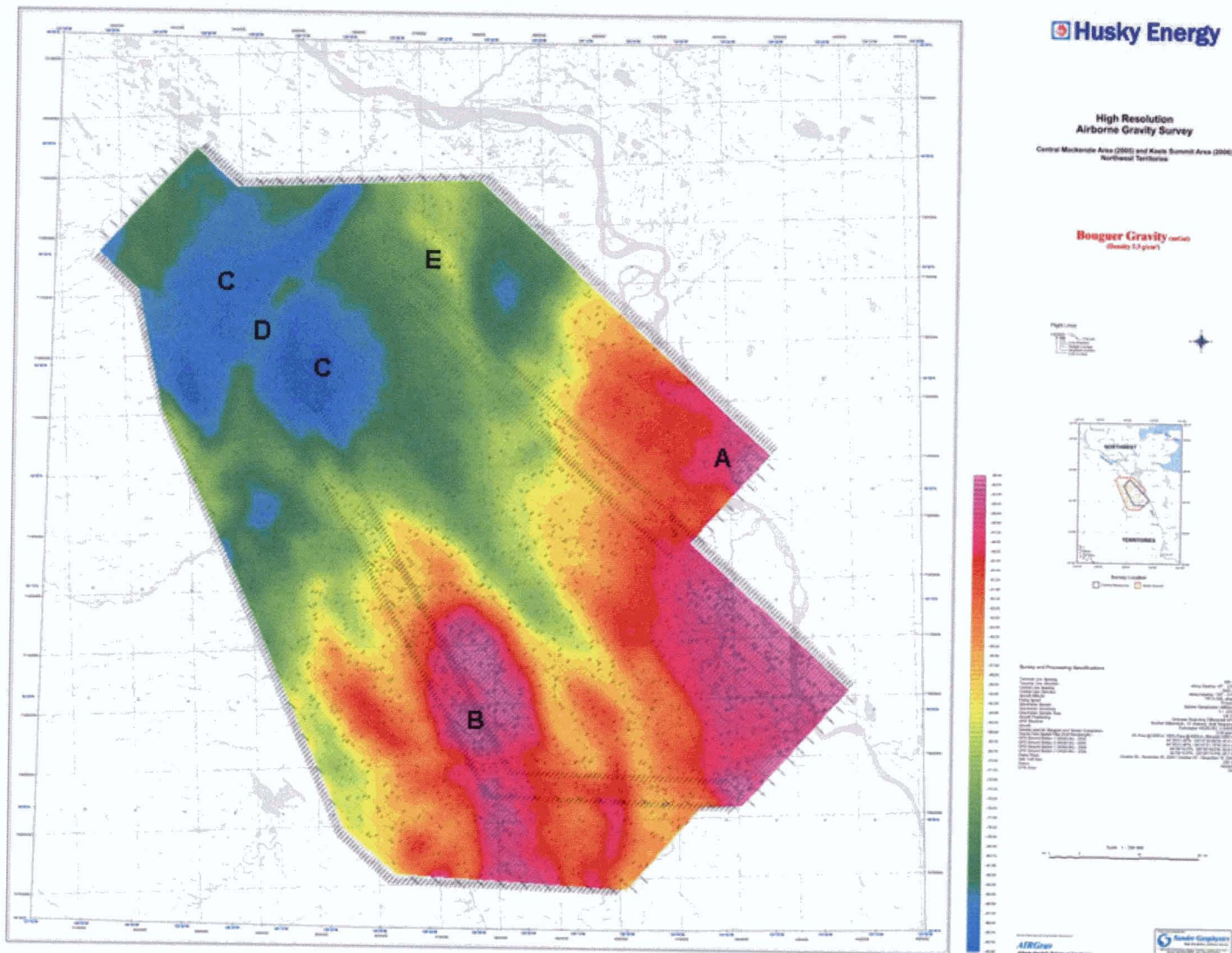


## 11. GRAVITY INTERPRETATION

The 2006 airborne gravity program was an add-on to the 2005. We see the continuation of a number of features from 2005 as well as a couple new ones. Feature A (Fig. 2) is the eastward extension of the Keele arch seen on the 2005 program. There appears to be a NE-SW oriented shift in the arch best seen on Figure 3, which creates a step in the gravity. This step appears to line up with the North end of the Red Dog anticline (feature B, Fig. 2) with the line of connection (line A', Fig. 3) being paralleled by the Keele River. This may indicate an old basement fault/lineament which has effected subsequent structuring. Feature E (Fig 2) is the Mackay Range outcrop and subsurface fault trend shown by E' (Fig. 3). It is interesting to note that the Mackay fault terminates exactly at the basement lineament A'. This suggests that the A' lineament forms a structural break between the areas on either side of it. The NW area of the gravity shows a very low density which corresponds with the known basin (two Cs, Fig 2). This basin has a thick Cretaceous section in it as well as the remains of the Tertiary Summit Creek formation. Feature D (Fig. 2) is the Gambil Mountains which run sub-perpendicular to the Mackenzie Mountains in this area. The consistent shape of the two Basins (C) across the Gambil gravity anomaly may suggest very late movement on the Gambil fault. In other words the basin was already formed then the Gambil fault thrust the rocks in the core of the basin to surface.

**Figure 1: Map of Survey Area Showing Survey Block**





**Figure 2 (Bouguer Gravity, Density 2.3 g/cm<sup>3</sup>)**

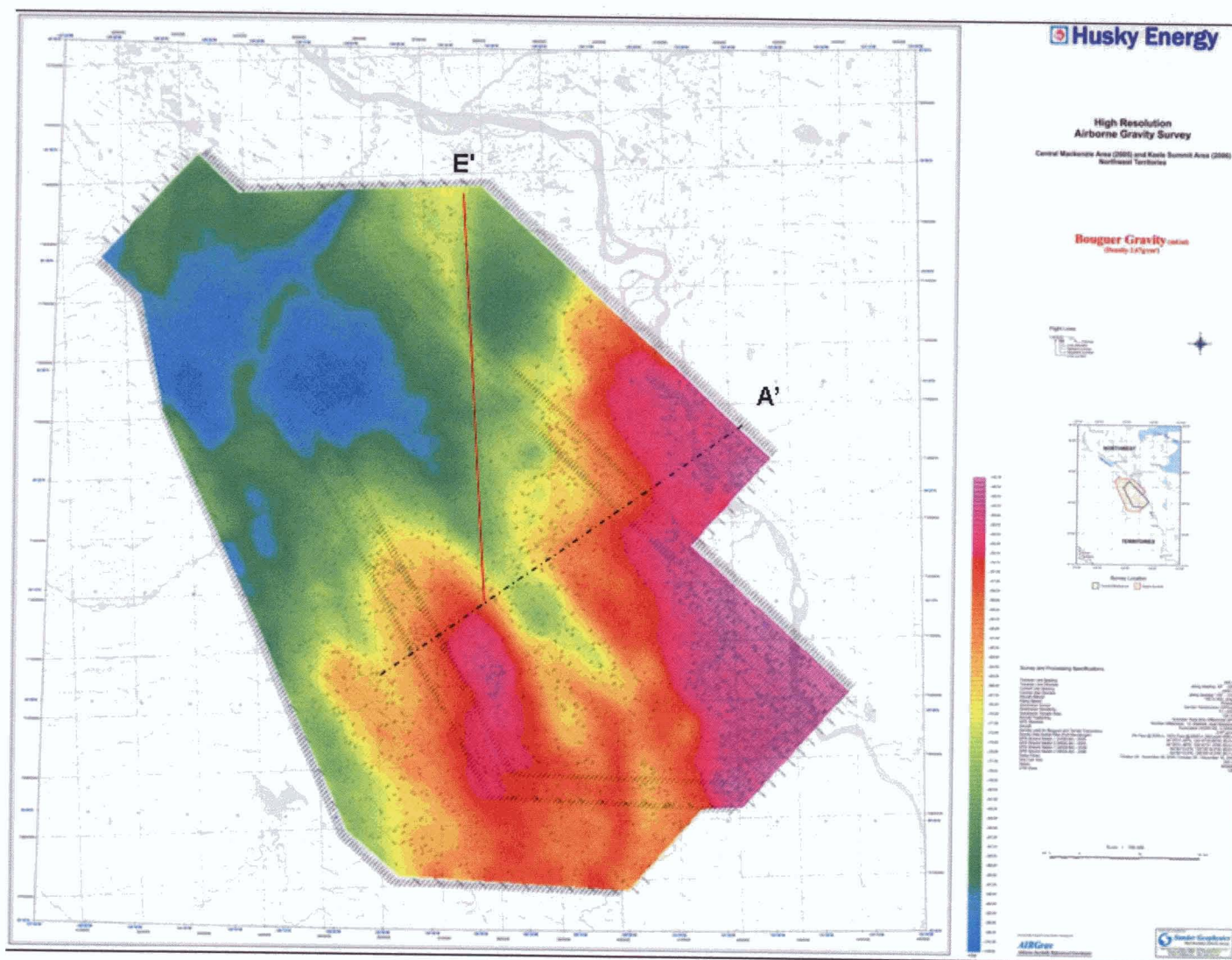


Figure 3 (Bouguer Gravity, Density 2.67 g/cm<sup>3</sup>)

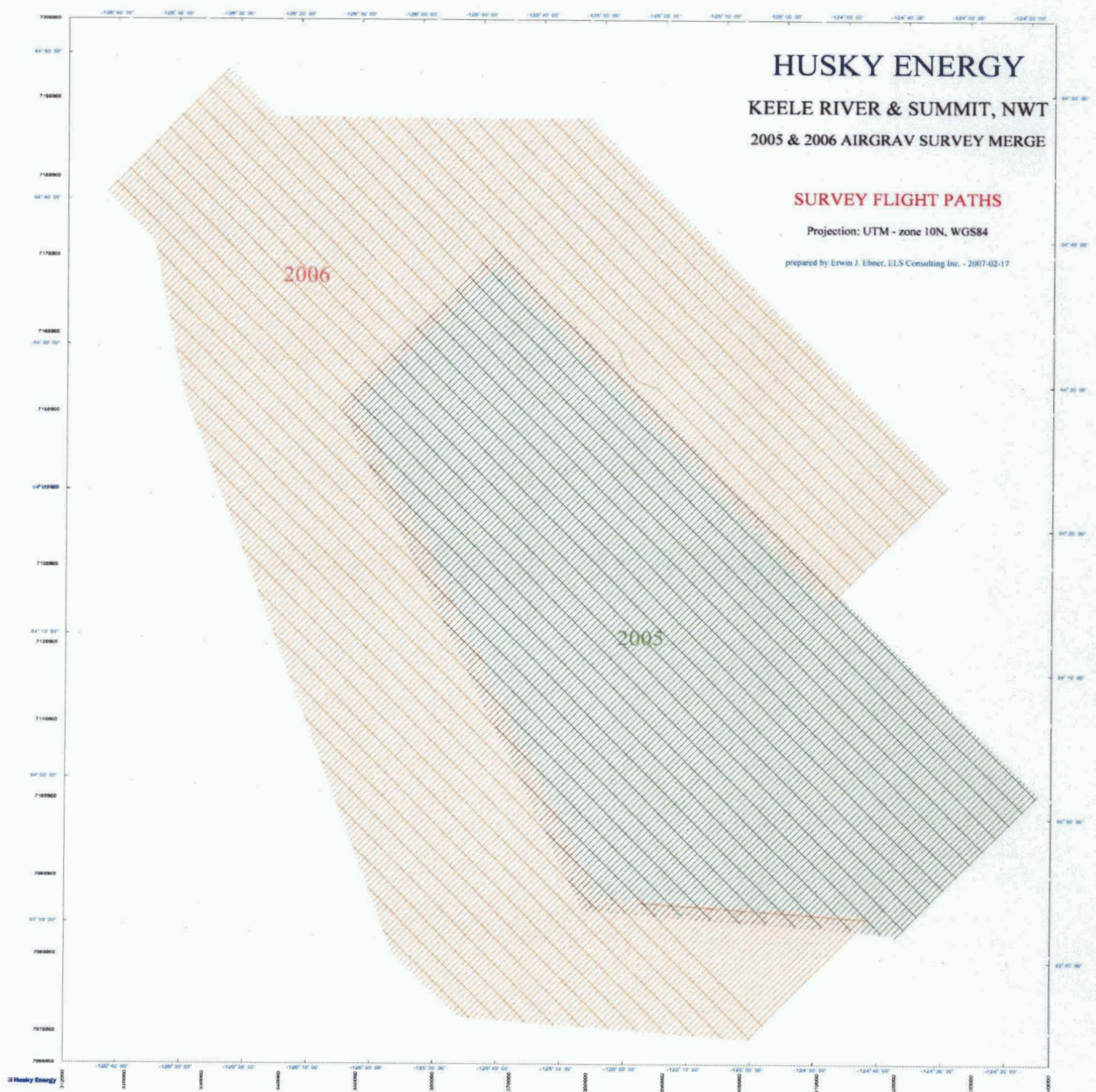


Figure 4 (Flightpath)



## Gravity to Seismic Correlation

The seismic section below shows a seismic section at the south end of the survey area (feature B.) The purple horizon that weaves across the middle of the section is a scaled version of the 3<sup>rd</sup> order polynomial residual. The gravity has a clear match to the structure across the line, following the highs and lows. Additional sections are included in paper and on the DVD that cross the basin E-W at several points from North to South.

