

FINAL REPORT

on

Data Acquisition and Processing

for the

Airborne Magnetic Survey

of

Death Valley, California

on behalf of the

United States Geological Survey

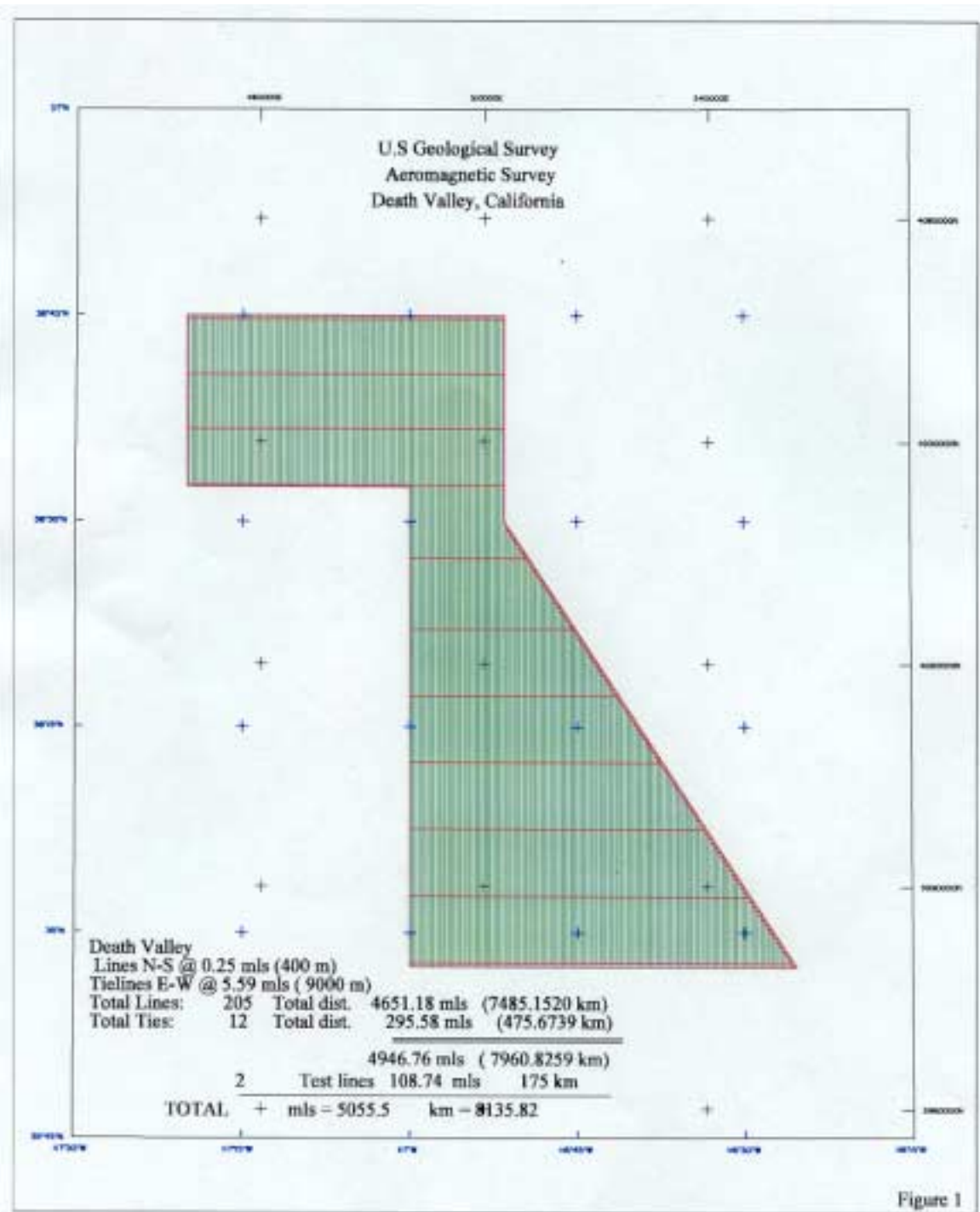
Brian Schacht P. Geoph.
Ottawa, Ontario, Canada
March, 2001

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1. INTRODUCTION

An aeromagnetic survey was flown over Death Valley, California, as well as three conjoined areas within western Nevada. The flying was completed between December 5, 2000, and January 14, 2001, by Fugro Airborne Surveys on behalf of the United States Geological Survey (see figure 1). A 1:100,000 scale contour map and digital grid of the total magnetic field were produced, as well as a digital grid of radar altimeter (ground clearance) data.



2. TECHNICAL SPECIFICATIONS

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This section describes in detail the guidelines followed throughout the performance of the project; tolerances and instruments are also presented here.

2.1 SURVEY LOCATION

The area is bounded by the following co-ordinates (WGS84 UTM and degrees X 1,000,000):

500000.00	3979126.00	35572348	-117000000
552103.00	3979126.00	35571847	-116252002
512687.00	4039215.00	36295343	-116513001
512646.00	4066946.00	36445341	-116513002
470243.00	4066988.00	36445340	-117200003
470163.00	4043879.00	36322342	-117200002
500000.00	4043828.00	36322345	-117000000

2.2 FLIGHT SPECIFICATIONS

Traverse Line Direction	E - W
Traverse Line Spacing	400 m
Control Line Direction	N - S
Control Line Spacing	approximately 7,500 m
Terrain Clearance	117-1217 m+ - see section 2.3 - "Flying Height"
Line kilometers	8135.82 (5055.5 miles)
Average Sampling Interval	7.5 m

2.3 TOLERANCES

Lines (or segments of lines crossing two control lines, or segments of control lines crossing several lines) were re-flown when any of the following tolerances were exceeded:

Navigation

- Nominal line spacing must not be exceeded by more than 50% for a distance of more than 3.2 km.

Flight Height

- In order to maintain similar elevations at all traverse and control line intersections, even when climbing or descending steeply, the Fugro *ACCUDRAPE* system utilizes a pre-planned digital drape surface which the onboard computer compares with the GPS xyz to feed corrections to the pilot.
- Deviations from the pre-planned drape elevation must not exceed 100 m. The precipitous mountains flanking the survey necessitated a pre-planned drape surface with ground clearance exceeding 1217 m (4000') over the valley (the radar altimeter maximum is 1217 m). Less than 1% of the data could be flown below 183 m (600').

Magnetic Diurnal

- Deviations must not be greater than 2 nT from a 2 minute chord. The ground station magnetometer operated during all data acquisition.

Airborne Magnetometer Noise

- "Maneuver" noise must not exceed an envelope of ± 0.1 nT over more than 10% of

high-pass filter.

- A standard Figure of Merit must be less than 1.5 nT.
- Heading errors must be within 1 nT between reciprocal headings.

2.4 SURVEY EQUIPMENT

Table 2.4.a lists major characteristics of the fixed-wing survey aircraft.

Registration	Endurance	Engines	Manufacturer	Type	No. of Seats	Average Speed
C-FZLK	6.5 hours	1 Turbine	Cessna	Caravan 208	3	75 m/sec

Table 2.4.a Survey Aircraft

Table 2.4.b lists the geophysical equipment installed in C-FZLK throughout the survey.

EQUIPMENT	MANUFACTURER	MODEL	TYPE
Data Acquisition System	Fugro Airborne Surveys	GeoDAS	Pentium computer based, real-time, data synchronization and recording
Magnetometer	Scintrex	CS-2	Cesium Vapour, 10 Hz Sampling, 0.005 nT Sensitivity, 0.001 nT Resolution
Compensator	RMS	AADC	27 Term
Digital Backup	Iomega	Zip Drive	100 Mb removable hard drive
Analogue Recorder	RMS	GR-33a-1	Dot Matrix
Radar Altimeter	TRT	AVH-8	10 Hz Sampling, Accuracy $\pm 2\%$
Barometric Altimeter	Rosemount	1241M	10 Hz Sampling, Accuracy ± 5 m
Omnistar Receiver	Trimble		Real-time differential GPS correction
GPS Receiver	Sercel	NR103	10 Channel
Video Camera	Panasonic	WVC 1302	Colour
Video Cassette Recorder	Panasonic	AG2400	NTSC

Table 2.4.b Airborne Geophysical Equipment

Table 2.4.c lists the components of the ground-based reference station.

EQUIPMENT	MANUFACTURER	MODEL	TYPE
Magnetometer	Scintrex	CS-2	Cesium Vapour, 2 Hz Sampling, 0.005 nT Sensitivity, 0.01 nT Resolution
GPS Receiver	Sercel	NR-103	10 Channel

Table 2.4.c Ground Reference Station

The ground magnetometer was mounted in a magnetically quiet area; its clock was synchronized with the GPS time signal. The GPS data logger records all of the raw range data stream. The *Trajecto* differential correction software matches the output from the airborne GPS system and the ground GPS system during the data reduction process.

Table 2.4.d lists the equipment and software used to perform the field processing.

EQUIPMENT	MANUFACTURE R	MODEL	TYPE
PC	Dell	Inspiron 7500	800 MHz Pentium
Printer	HP	HP950C	A4 Colour
Data Processing Software	Fugro Airborne Surveys	Gmaps	DOS & Windows
Image Processing Software	ERMapper	Version 5.5	Windows 95/98
GPS Processing Software	Sercel	Trajecto	DOS

Table 2.4.d Field Processing System

3. PERSONNEL

NAME	TITLE	PROJECT POSITION
Robb, Jeff	Aircraft Maintenance	Aircraft Maintenance
Lamirande, Ken	Electronics Technician	Electronics Operator
Reed, Travis	Electronics Technician	Electronics Operator
Lyall, Ron	Operations Manager	Processor, Logistics
Williston, Mark	Pilot	Survey Pilot
Thomas, Jeff	Pilot	Survey Pilot

Table 3 Field Project Personnel

4. SURVEY OPERATIONS

4.1 GENERAL

The production phase of the project began in Bishop, California, on December 5th, 2000, and the final production flight was made on January 14th, 2001. The Comfort Inn provided crew accommodation and space for the field processing office.

4.2 DIURNAL CONDITIONS

Magnetic diurnal variation was exceptionally quiet. Deviations never reached the specification limit.

4.3 GENERAL WEATHER CONDITIONS

Weather conditions were frequently unfavourable for survey flying due to high turbulence or cloud cover in the mountains. Ten days were lost.

4.4 QUALITY CONTROL AND FIELD PROCESSING

- To check the data for adherence to contract specifications and move the data closer to the final stage, the following procedures were followed for each flight (details in section 6):
 - downloading and verification of aircraft data;
 - downloading and verification of GPS and magnetic base station data;
 - post-processing of GPS data using SERCEL TRAJECTOGRAPHY software;
 - merging of navigation data with geophysical data including transformation of coordinates from WGS84 latitude/longitude to UTM x, y coordinates in the local spheroid;
 - creation of flight path plots and evaluation of compliance with contract specifications;
 - spike and null value location and removal from the magnetic and altimeter data;
 - computing of a drape surface quality control field for evaluation of compliance with the contract specifications;
 - computing of magnetic noise channel for evaluation of data quality and compliance with contract specifications;
 - evaluation of diurnal data quality, and compliance with contract specifications;
 - correction of magnetic data for I.G.R.F. gradient;
 - noise filtering of magnetic and altimeter fields;
 - correction of magnetic field for altitude deviations;
 - backing-up of all field data.

At regular intervals, the corrected magnetic data were levelled and gridded for quality inspection including real-time shade enhancement.

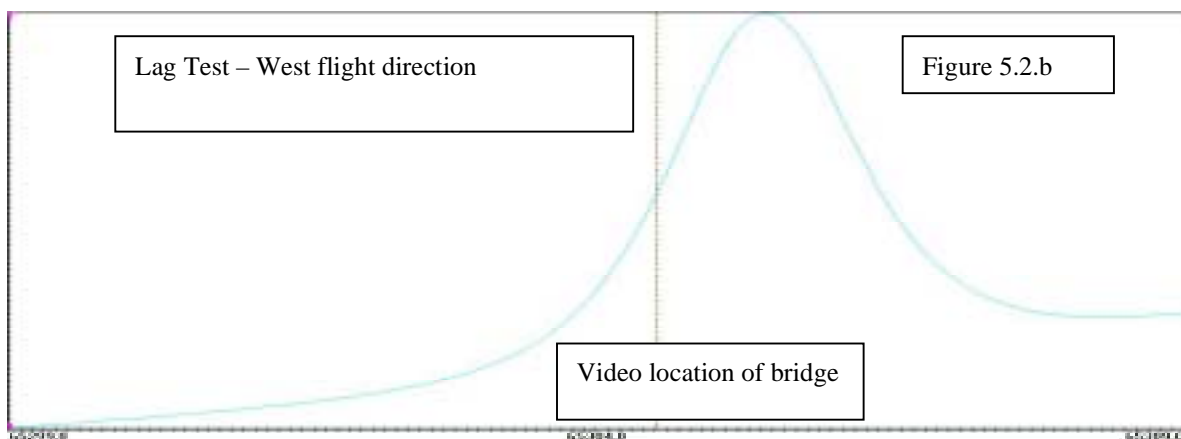
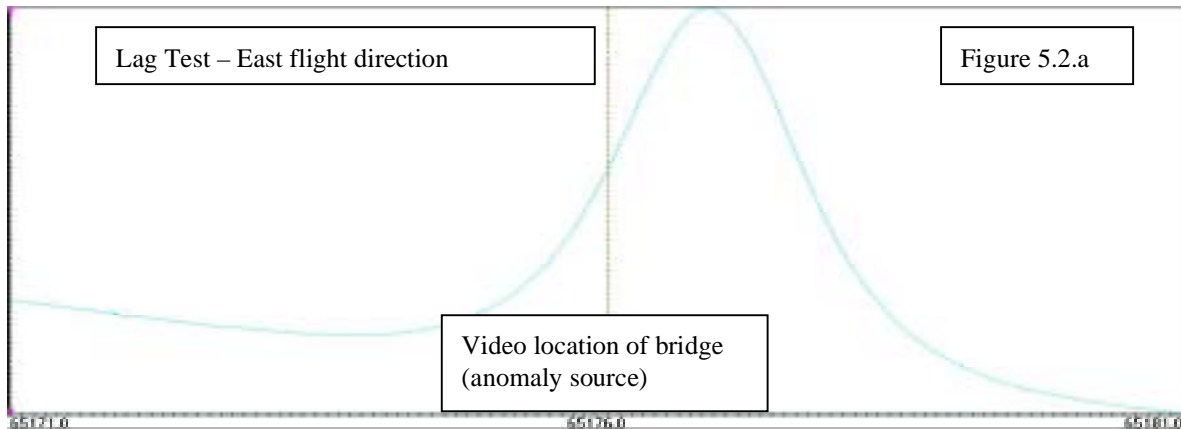
5. CALIBRATION AND TEST RESULTS

5.1 GPS BASE STATION

To apply post-flight differential GPS corrections to the survey data, a GPS base station was installed near the crew's hotel. The location of the GPS base station antenna was determined by averaging positions over a 24 hour period. The location was 37° 22' 17.28" N latitude, 118° 22' 8.46" W longitude, elevation 1,255 m, on the WGS spheroid.

5.2 MAGNETIC LAG TEST

The camera on-board the aircraft records its position, A, relative to the ground, at time t_0 . In fact the sensor will arrive over A at time t_1 ($>t_0$). Furthermore, because of electronic delays, the reading at time t_1 will not be recorded until time t_2 ($>t_1$). The difference t_2-t_0 represents the lag between the actual aircraft position and the x y position tied to the magnetic reading on disk. A lag test was performed by flying the aircraft at survey altitude in opposite directions over a sharp magnetic feature. The position of the magnetic feature was referenced to a visible feature recorded by the video system, in this case a bridge, which was the anomaly source. By superimposing a plot of the east-west anomaly over the west-east anomaly, the video-picked position of the bridge can be transposed onto its counterpart; and one-half the difference between the two video-picked positions equals the magnetic system lag. The lag was 0.7 seconds, or 7 magnetic samples, for aircraft C-FZLK. These values were used to correct for magnetic system lag throughout the survey.

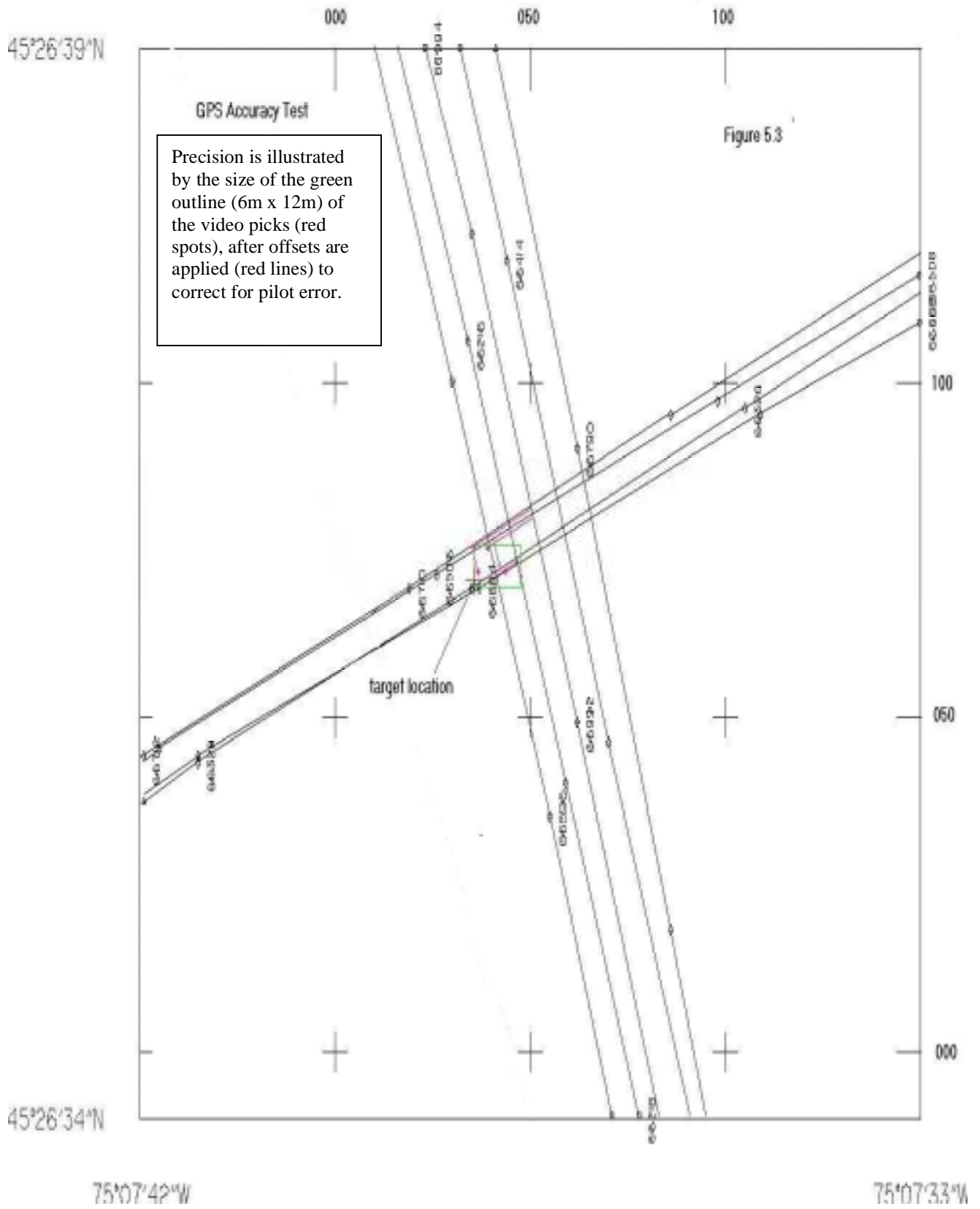


5.3 GPS LAG / ACCURACY TEST

A cloverleaf flown over the established co-ordinates of the Canadian Geological Survey test site was used to measure the lag in the GPS positioning, with regard to the video camera position. A value of 0.2 seconds resulted in a best fit with the video position. Once the lag is applied (as in figure 5.3) the cloverleaf intersection is used to test the accuracy of the GPS positioning.

Aircraft:		Cessna Caravan	
Registration:		C-FZLK	
Date:		November 25, 2000	
Location:		Bourget, Ontario, Canada	
Altitude:		400 ft mean terrain clearance	
DIRECTION	FIDUCIAL CLOSEST TO TARGET (from video)	OFFSET FROM TARGET DUE TO PILOT ERROR (estimate in metres & direction)	Line # on Video
South	66216.56	0	Line 10
West	66326.92	3 N	Line 11
North	66413.50	20 E	Line 12
East	66506.22	5 N	Line 13
South	66595.44	5 W	Line 14
West	66709.76	5 N	Line 15
East	66884.10	0	Line 17
North	66992.44	15 E	Line 18

TABLE 5.3 GPS LAG / ACCURACY TEST



5.4 FIGURE OF MERIT (FOM)

The figure of merit is the measurement of the ability of the compensation system to remove the effects of aircraft maneuvers from the total field data. During the FOM test the aircraft is flown into a quiet magnetic area and put through a series of pitches ($\pm 5^\circ$), rolls ($\pm 10^\circ$) and yaws ($\pm 5^\circ$) to examine the noise remaining in the signal after the 27 term automatic compensation algorithm has been applied to the data.

Figure of Merit				
Aircraft:	Cessna Caravan			
Registration:	C-FZLK			
Magnetometer:	Cesium vapor, stinger mounted			
Sampling Rate:	10 Hz			
Date:	December 2, 2000			
Location:	Bishop, California			
HEADING	MANOEUVER	VALUE (nT)	HEADING TOTAL (nT)	
NORTH	PITCH	0.18	0.32	
	ROLL	0.08		
	YAW	0.06		
EAST	PITCH	0.12	0.27	
	ROLL	0.07		
	YAW	0.08		
SOUTH	PITCH	0.08	0.18	
	ROLL	0.06		
	YAW	0.04		
WEST	PITCH	0.08	0.20	
	ROLL	0.06		
	YAW	0.06		
FOM VALUE			0.97	nT
AVERAGE MANEUVER NOISE (FOM / 12)			0.08	nT

Table 5.4 C-FZLK Figure of Merit

5.5 ALTIMETER CALIBRATION

On November 24, 2000, the radar, barometric, and GPS altimeters were compared by flying at terrain clearances of 200', 300', 400', 500', 600', 800', and 1000' over a flat portion of the Ottawa river. The results reconfirmed that all altimeters aboard C-FZLK are functioning normally.

6. FINAL DATA PROCESSING

Final data reduction was undertaken at the Fugro Airborne Surveys processing center in Ottawa, Canada between January and February, 2001. In general, final processing consisted of the following operations:

- final levelling of the total field magnetic data;
- image and 1:100,000 scale map analysis of the total field and levelling compensations by a geophysicist for any levelling, positioning, or gridding errors;
- final gridding and micro-levelling;
- imaging and plotting of magnetic field;
- gridding of radar altimeter data
- archiving of final data.

The final projection was the Universal Transverse Mercator using the NAD83 (WGS84) spheroid, with a false easting of 500,000 m, false northing of 0 m, scale factor of 0.9996 and central meridian of 117° West.

Further details of the magnetic processing are provided below.

6.1 Noise Editing

An automatic editing routine, employing 4th differences of the magnetic field, removed nulls and spikes down to the noise level, and located abrupt level shifts.

6.2 Noise Filtering

We filtered all data in the frequency domain with a cutoff 0.061 (wavelengths per sample interval) rolloff 0.030 (wavelengths per sample interval). This filter approaches 100% removal of anomalies of wavelength 99 metres (13.2 samples x average speed of 7.5 metres/sample) or less. It approaches 0% removal of anomalies of wavelength 163 metres (21.7 samples x average speed of 7.5 metres/sample) or more. This filter should have no effect on any real, geological-source anomalies; or even the narrowest anomaly from cultural sources on the ground surface. The minimum ground clearance is about 150 metres (rarely encountered) and the minimum wavelength produced at 150 metres is roughly $2 \times 150 = 300$ metres. Thus all real wavelengths are a safe distance from the 163 metre limit of the filter.

6.3 Diurnal Subtraction

A test was made to verify the effectiveness of diurnal subtraction: Long period diurnal variations were subtracted from the air data, as they are more likely to correlate, and the residual magnetic field was leveled. As no improvement was noted in the required levelling compensations, diurnal subtraction was not employed.

6.4 IGRF Correction

The IGRF regional value was calculated using the 1995 model updated to the mid-survey date (2001.0) using the corrected GPS elevations. Using the actual elevations for IGRF correction has the added benefit of correcting for the magnetic effect of altitude variations within the

Earth's primary field. Corrections for vertical movements within the secondary magnetic field induced by the Earth's crust is discussed in the following section, 6.5.

6.5 Upward/Downward Continuation

As the terrain clearance drops, the vertical magnetic gradients can become very high; and even minor deviations from the prescribed drape surface may produce significant changes in the measured magnetic field. The Taylor Expansion¹ applies the required upward and downward continuations to the magnetic field to simulate measurements from the prescribed altitude. The resulting magnetic field profiles were input to the levelling process.

6.6 Levelling

The lines (traverse lines) and tie-lines (control lines) of an aeromagnetic survey form a network, and the points where they cross are called intersections. At each intersection the magnetic values should be identical. In practice they differ as a result of:

- time variations of the magnetic field;
- heading effects;
- altitude differences;
- position errors;
- cultural or instrument noise.

In the levelling process, it is assumed that most of the required level adjustments will vary smoothly along each line or tie-line. The network of line minus tie-line differences at the intersections is analyzed to produce a matrix of misclosures. These misclosures were reduced to zero through an iterative process of tilting the profile baselines and moving the intersection locations. Compensation values applied at adjacent tie-lines were not allowed to differ by more than 5 nT. Intersection movements were restricted to a maximum of 4 samples (about 30 metres). These maximums were very rarely required. None of the 1,121 intersections needed manual corrections.

6.7 Gridding

Gridding was done by the Akima method, using data from all lines and tie-lines. A gridding interval of 1/3 the line spacing was used (133 m).

6.8 Grid Levelling

The final stage of levelling consisted of applying a grid-levelling routine to the gridded data to remove small residual errors that are not properly removed by conventional levelling of the line data²

¹ Pilkington, M., and Thurston, J. B., 2001. *Draping corrections for aeromagnetic data: line versus grid based approaches*; Exploration Geophysics, in press.

² Minty, B.R.S., 1991: *Simple micro-levelling for aeromagnetic data*; Exploration Geophysics, v.22, p. 591-592.

7. DELIVERABLES

7.1 MAPS

Two copies of the magnetic field contour map are presented at 1:100,000 scale with UTM registration plus screened flight path, in black and white, on mylar.

7.2 REPORT

This report covers data acquisition and processing, and is provided in two hard copies plus a digital archive in *Microsoft Word* format.

7.3 DIGITAL ARCHIVES

Files: raw and final processed profile data, and final magnetic and radar altitude grids;
Format: The ASCII format is used for profiles, and *Geosoft* binary format is used for grids.
A full format description is included in the appendix .
Media: CD-ROM.
Copies: two

We trust this survey will assist your mapping program; and we remain available for questions at any time.

Respectfully Submitted,

Brian Schacht P. Geoph.

APPENDIX
DIGITAL ARCHIVE FORMAT DESCRIPTOR

DIGITAL ARCHIVE DESCRIPTION OF PROFILE DATA

DEATH VALLEY, CALIFORNIA

Digital Archive is Ascii.

Ascii filename: **california.profile**

250 bytes I 10 format

1-10 Line number X 100 + part number
 11-20 Flight number
 21-30 Latitude **NAD27** (decimal degrees)
 31-40 Longitude
 41-50 UTM metres **NAD27** (CM 117 degrees west)
 51-60 UTM metres
 61-70 Latitude **WGS84** (decimal degrees)
 71-80 Longitude
 81-90 UTM metres **WGS84** (CM 117 degrees west)
 91-100 UTM metres
 101-110 Fiducial (seconds UTC X 10 increments by 1)
 111-120 Date (ddmmyy)
 121-130 Radar (m X 100)
 131-140 Baro (m X 100)
 141-150 GPS elevation (m X 100)
 151-160 Diurnal (.001 nT)
 161-170 Raw Magnetics (.001 nT) edited, lag applied.
 171-180 Filtered Magnetics (.001 nT)
 181-190 Filtered Magnetics - I.G.R.F. (.001 nT)
 191-200 I.G.R.F. (2000.9)
 201-210 Differential Up/Down corr. Magnetics (.001 nT)
 211-220 Levelled Magnetics (.001 nT)
 221-230 Final Magnetics (.001 nT)
 231-240 Compensation (.001 nT) from TL levelling
 241-250 Compensation (.001 nT) from micro levelling

Fugro Airborne Survey's direction codes are as follows:

- 1: Northbound
- 2: Eastbound
- 3: Southbound
- 4: Westbound

The archive file contains the following lines:

ARCHIVE FILE: **california.archive**

LINE-ID	DIR	FST-FID (X10)	LST-FID (X10)	TAPE	BLOCK	REC	SAMPLES
-----	---	-----	-----	----	-----	---	-----
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10201	1	57317	57633	1	3202	1	3161
10301	3	57805	58137	1	6363	1	3321

10401	1	58333	58680	1	9684	1	3471
10501	3	58827	59175	1	13155	1	3481
10601	1	59378	59711	1	16636	1	3331
10701	3	59874	60216	1	19967	1	3421
10801	1	60372	60692	1	23388	1	3201
10901	3	60863	61204	1	26589	1	3411
11001	1	61368	61712	1	30000	1	3441
11101	3	62470	62805	1	33441	1	3351
11201	1	62997	63320	1	36792	1	3231
11301	3	63483	63825	1	40023	1	3421
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11701	3	65484	65815	1	53657	1	3311
11801	1	65965	66298	1	56968	1	3331
11901	3	66858	67223	1	60299	1	3651
12001	1	67385	67721	1	63950	1	3361
12101	3	68016	68355	1	67311	1	3391
12201	1	68523	68861	1	70702	1	3381
12301	3	69021	69365	1	74083	1	3441
12401	1	69526	69861	1	77524	1	3351
12501	3	70035	70369	1	80875	1	3341
12601	1	70565	70909	1	84216	1	3441
12701	3	71675	72011	1	87657	1	3361
12801	1	72199	72524	1	91018	1	3251
12901	3	72693	73040	1	94269	1	3471
13001	1	73211	73544	1	97740	1	3331
13101	3	56169	56532	1	101071	1	3631

13201	1	56725	57075	1	104702	1	3501
13301	3	57228	57588	1	108203	1	3601
13401	1	57777	58118	1	111804	1	3411
13501	3	58255	58611	1	115215	1	3561
13601	1	58801	59151	1	118776	1	3501
13701	3	59635	59979	1	122277	1	3441
13801	1	60138	60497	1	125718	1	3591
13901	3	60669	61010	1	129309	1	3411
14001	1	61179	61569	1	132720	1	3901
14101	3	61732	62077	1	136621	1	3451
14201	1	62245	62605	1	140072	1	3601
14301	3	62807	63140	1	143673	1	3331
14401	1	63306	63689	1	147004	1	3831
14501	3	63857	64203	1	150835	1	3461
14601	1	64359	64717	1	154296	1	3581
14701	3	65016	65361	1	157877	1	3451
14801	1	65532	65897	1	161328	1	3651
14901	3	66057	66398	1	164979	1	3411
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15201	1	67618	67966	1	175442	1	3481
15301	3	68150	68498	1	178923	1	3481
15401	1	68680	69033	1	182404	1	3531
15501	1	70448	70802	1	185935	1	3541
15601	3	69954	70306	1	189476	1	3521
15701	1	69284	69641	1	192997	1	3571
15801	3	68659	69020	1	196568	1	3611
15901	3	67470	67845	1	200179	1	3751

16001	1	68003	68355	1	203930	1	3521
16101	1	66832	67178	1	207451	1	3461
16201	3	66257	66622	1	210912	1	3651
16301	1	65616	65982	1	214563	1	3661
16401	3	65087	65446	1	218224	1	3591
16501	1	64482	64838	1	221815	1	3561
16601	3	63886	64249	1	225376	1	3631
16701	1	63255	63621	1	229007	1	3661
16801	3	62699	63070	1	232668	1	3711
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17001	3	85574	85871	1	239460	1	2971
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17901	3	60085	60930	1	304839	1	8451
17902	3	61160	61525	1	313290	1	3651
18001	1	61709	63120	1	316941	1	14111
18101	3	63550	64737	1	331052	1	11871
18201	1	64931	66355	1	342923	1	14241
18301	3	73525	74634	1	357164	1	11091
18402	1	75260	76170	1	368255	1	9101
18403	1	72995	73260	1	377356	1	2651
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18601	1	77781	78960	1	391590	1	11791
18701	3	79099	80190	1	403381	1	10911
18801	1	80345	81526	1	414292	1	11811
18901	3	81898	82997	1	426103	1	10991
19001	1	83388	84554	1	437094	1	11661
19101	3	56456	57802	1	448755	1	13461
19201	1	57955	59215	1	462216	1	12601
19301	3	59411	60810	1	474817	1	13991
19401	1	61151	62424	1	488808	1	12731
19502	3	57921	59149	1	501539	1	12281
19602	3	63306	64511	1	513820	1	12051
19701	3	58450	59641	1	525871	1	11911
19801	1	72673	74014	1	537782	1	13411
19901	3	57786	58990	1	551193	1	12041
20001	1	72810	74165	1	563234	1	13551
20101	1	71464	72790	1	576785	1	13261
20201	3	71588	72709	1	590046	1	11211
20301	3	63014	64235	1	601257	1	12211
20401	1	72637	73883	1	613468	1	12461
20501	1	72401	73679	1	625929	1	12781
20601	1	68737	70032	1	638710	1	12951
20702	1	59347	60283	1	651661	1	9361
20802	3	60465	61289	1	661022	1	8241
20902	1	61483	62401	1	669263	1	9181
21002	3	62706	63521	1	678444	1	8151
21102	1	63709	64590	1	686595	1	8811

21202	3	64741	65541	1	695406	1	8001
21302	1	65726	66602	1	703407	1	8761
21402	3	66868	67633	1	712168	1	7651
21502	1	67800	68634	1	719819	1	8341
21602	3	68855	69609	1	728160	1	7541
21702	1	64867	65837	1	735701	1	9701
21802	3	66112	66819	1	745402	1	7071
21901	1	67035	67947	1	752473	1	9121
22001	3	68098	68788	1	761594	1	6901
22101	1	59957	60785	1	768495	1	8281
22201	3	61284	61971	1	776776	1	6871
22301	1	62142	62900	1	783647	1	7581
22401	3	63070	63729	1	791228	1	6591
22501	1	63931	64736	1	797819	1	8051
22601	3	64902	65557	1	805870	1	6551
22701	1	65756	66504	1	812421	1	7481
22801	3	66724	67361	1	819902	1	6371
22901	1	67584	68305	1	826273	1	7211
23001	3	68466	69090	1	833484	1	6241
23101	1	69328	70002	1	839725	1	6741
23201	3	70176	70800	1	846466	1	6241
23301	1	70959	71600	1	852707	1	6411
23401	3	71799	72373	1	859118	1	5741
23501	1	59500	59991	1	864859	1	4911
23502	1	64816	64975	1	869770	1	1591
23601	3	60184	60739	1	871361	1	5551
23701	1	60894	61494	1	876912	1	6001
23801	3	61736	62291	1	882913	1	5551

23901	1	62467	63049	1	888464	1	5821
24001	3	63199	63737	1	894285	1	5381
24101	1	63900	64454	1	899666	1	5541
24201	3	64652	65177	1	905207	1	5251
24301	1	65350	65885	1	910458	1	5351
24401	3	66125	66625	1	915809	1	5001
24501	1	67102	67626	1	920810	1	5241
24601	3	67804	68297	1	926051	1	4931
24701	1	68481	68985	1	930982	1	5041
24801	3	69168	69653	1	936023	1	4851
24901	1	69811	70304	1	940874	1	4931
25001	3	70595	71066	1	945805	1	4711
25101	1	71288	71769	1	950516	1	4811
25201	3	71928	72392	1	955327	1	4641
25301	1	70020	70469	1	959968	1	4491
25401	3	70640	71087	1	964459	1	4471
25501	1	59595	60040	1	968930	1	4451
25601	3	60220	60650	1	973381	1	4301
25701	1	60824	61247	1	977682	1	4231
25801	3	61770	62192	1	981913	1	4221
25901	1	62369	62795	1	986134	1	4261
26001	3	62988	63392	1	990395	1	4041
26101	1	63595	63989	1	994436	1	3941
26201	3	64183	64558	1	998377	1	3751
26301	1	64733	65098	1	1002128	1	3651
26401	3	65258	65615	1	1005779	1	3571
26501	1	65790	66143	1	1009350	1	3531
26601	3	66666	67019	1	1012881	1	3531

26701	1	67204	67549	1	1016412	1	3451
26801	3	67737	68070	1	1019863	1	3331
26901	3	68376	68711	1	1023194	1	3351
27001	1	68865	69178	1	1026545	1	3131
27101	3	69315	69634	1	1029676	1	3191
27201	1	69786	70086	1	1032867	1	3001
27301	3	70227	70524	1	1035868	1	2971
27401	1	70669	70961	1	1038839	1	2921
27501	3	71098	71380	1	1041760	1	2821
27601	1	71524	71795	1	1044581	1	2711
27701	3	71939	72193	1	1047292	1	2541
27801	3	65320	65554	1	1049833	1	2341
27901	1	65694	65945	1	1052174	1	2511
28001	3	66094	66302	1	1054685	1	2081
28101	1	66456	66683	1	1056766	1	2271
28201	3	66822	67024	1	1059037	1	2021
28301	1	67173	67378	1	1061058	1	2051
28401	3	67523	67710	1	1063109	1	1871
28501	1	67869	68052	1	1064980	1	1831
28601	3	68401	68573	1	1066811	1	1721
28701	1	68744	68932	1	1068532	1	1881
28801	3	69080	69242	1	1070413	1	1621
28901	1	67499	67657	1	1072034	1	1581
29001	3	67196	67341	1	1073615	1	1451
29101	1	66922	67069	1	1075066	1	1471
29201	3	66623	66757	1	1076537	1	1341
29301	1	66378	66502	1	1077878	1	1241
29401	3	66085	66198	1	1079119	1	1131

29501	1	65859	65964	1	1080250	1	1051
29601	3	65590	65688	1	1081301	1	981
29701	1	65366	65451	1	1082282	1	851
29801	3	65114	65195	1	1083133	1	811
29901	1	64875	64957	1	1083944	1	821
30001	3	64628	64714	1	1084765	1	861
30101	1	64392	64479	1	1085626	1	871
30201	3	64137	64219	1	1086497	1	821
30301	1	63912	63997	1	1087318	1	851
30401	3	63643	63726	1	1088169	1	831
30501	1	63416	63504	1	1089000	1	881
500101	2	69689	70298	1	1089881	1	6091
500201	4	70499	71137	1	1095972	1	6381
500301	2	71287	71903	1	1102353	1	6161
500401	4	72121	72720	1	1108514	1	5991
500501	2	58198	58428	1	1114505	1	2301
500601	4	58676	59021	1	1116806	1	3451
500701	2	59301	59707	1	1120257	1	4061
500801	4	59987	60479	1	1124318	1	4921
500901	2	60702	61280	1	1129239	1	5781
501001	4	61549	62211	1	1135020	1	6621
501101	2	62464	63217	1	1141641	1	7531
501201	1	70083	71005	1	1149172	1	9221

DIGITAL ARCHIVE DESCRIPTION OF GRID DATA

CLIENT	U.S.G.S
NAME OF SURVEY	AEROMAGNETIC SURVEY of
CALIFORNIA	
AREA NAME	DEATH VALLEY
CONTRACTOR	FUGRO AIRBORNE SURVEYS
JOB CODE	655
GRID ARCHIVE NAME	CALIF_TF.GRD
FORMAT	GEOSOFT BINARY GRID
CONTENT	TOTAL MAGNETIC INTENSITY
CREATION DATE	February 15, 2001
NUMBER of ROWS and COLUMNS	704 640
PIVOTAL POSITION (X,Y)	470022 3978828
CELL SIZE	133m
UNIT	nT
UNIT FACTOR	0.001
MINIMUM VALUE (nT)	-540.011
MAXIMUM VALUE (nT)	394.056
MEAN VALUE (nT)	-101.347
GRID ARCHIVE NAME	CALIF_RADAR.GRD
FORMAT	GEOSOFT BINARY GRID
CONTENT	RADAR
CREATION DATE	March 7, 2001
NUMBER of ROWS and COLUMNS	704 640
PIVOTAL POSITION (X,Y)	470022 3978828
CELL SIZE	133m
UNIT	m
UNIT FACTOR	0.01
MINIMUM VALUE (m)	168
MAXIMUM VALUE (m)	1217 (instrument maximum)
MEAN VALUE (m)	869

PROJECTION INFORMATION :

DATUM	NAD83
SHEROID	WGS84
PROJECTION	UTM
CENTRAL MERIDIEN	117 West
FALSE EASTING	500000 m
FALSE NORTHING	0 m
SCALE FACTOR	0.9996