Abridged Gravity Operations Report

EL27878 – Data Trade

Hess Corporation

11/30/2012

Metric Coordinates:	Projection:	Transverse Mercator
	True Origin:	135°00' E, 0°00' N
	Coordinates at Origin:	500'000.000m E, 1'000'000.000m N
	Datum:	GDA94 – Australia
	Spheroid:	GRS 1980
Geographic Coordinates:	Datum:	WGS84
	Spheroid:	WGS84
Magnetic Declination		4.5° West
Elevation	Orthometric:	Extracted from client provided DEM, in meters relative to mean sea level

Data acquisition:	Gravity stations
Equipment:	Scintrex CG-5 Autograv – Lacoste&Romberg mod.G
Earth Tide Corrected residual Gravity maximum drift	0.1 mGal
Drift and tide corrected Observed Gravity repeteability	0.1 mGal
Stations repeat rate	3%

Applied Techinque :	Gravity stations along seismic lines (Fig.8)
Equipment:	#4 LaCoste&Romberg mod.G #6 Scintrex CG-5 Autograv –

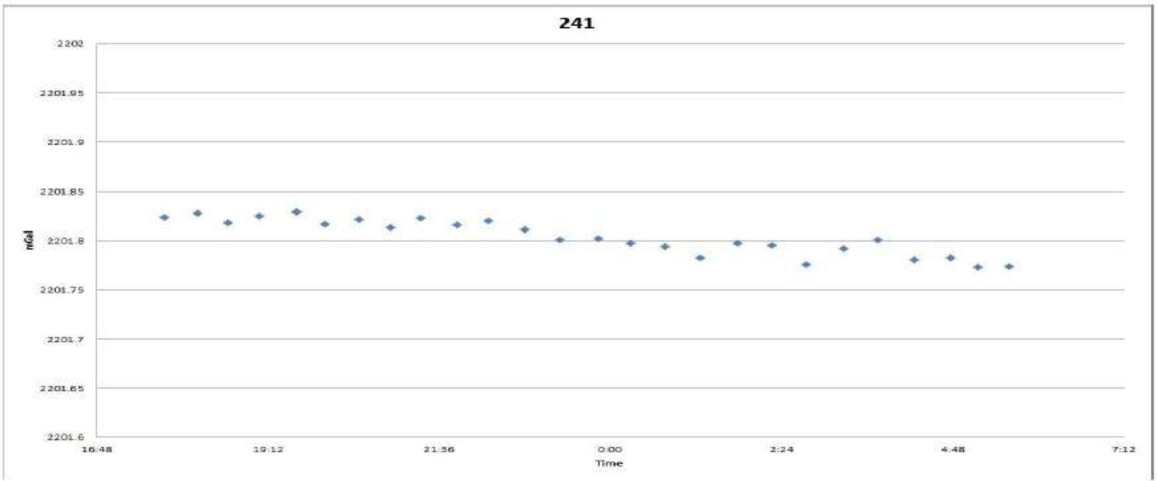
Surface gravity was observed with a spacing of 100 meters at pre-planned locations.

Before and during production, periodical instrument checks were performed

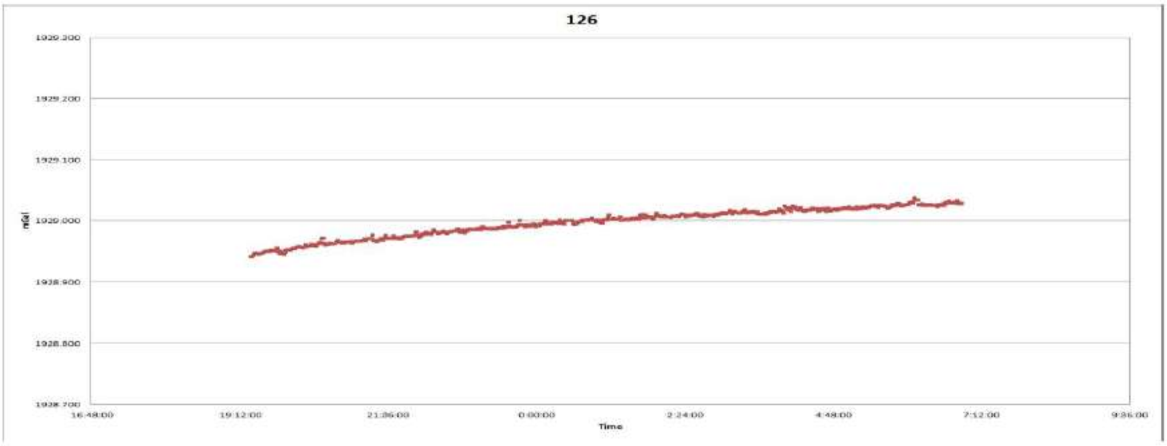
- Overnight drift test to check the internal meter drift
- Short Base Line Test to check readings repeteability

Overnight Drift Test

The change of the length of the gravimeter spring – approximately a linear stretching over time – produces an apparent change in the gravity measurements over the time, predictable when linear. This aspect of the gravimeter performance QC is checked through a so called “Drift test” usually performed overnight.For the L&R meters the test is usually made at the beginning of the survey, altought the daily drift QC is performed during the whole survey by the field reading procedures (“loop-closure”). The Scintrex CG-5M meters provide a internal software compensation of this drift, based on a user-provided estimate on the drift rate obtained by the drift-test (mGal/day).



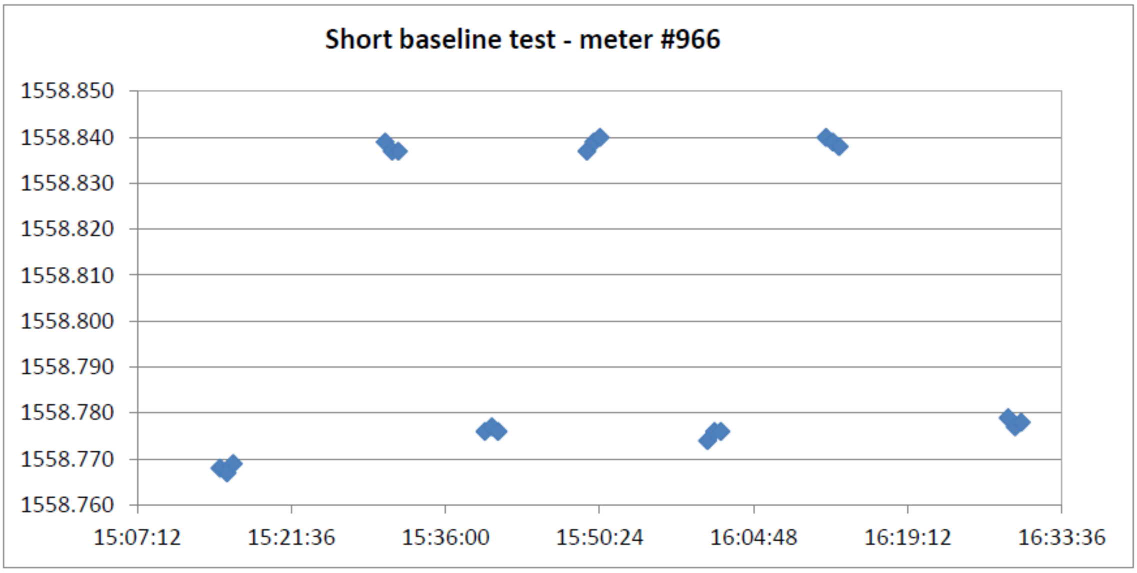
Drift test for gravimeter Lacoste and Romberg 241



. Drift test for gravimeter Scintrex CG5 050600126

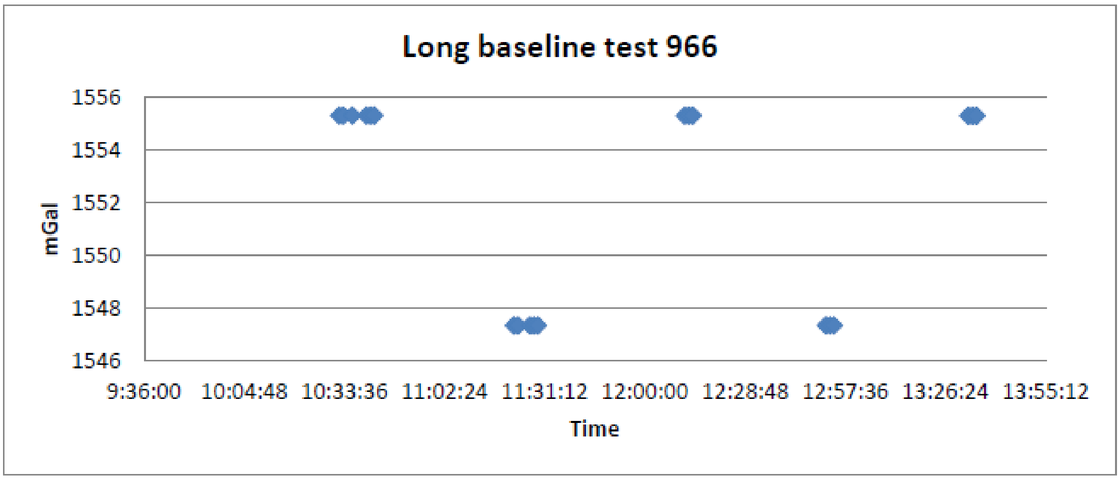
Short and Long Baseline Test

The test are carried to check data repetability and stability. The short baseline test is usually carried out at the camp. Gravity meter stability is tested over a two stations at 30-50 m distance. Five measurements are recorded at every site. The graphs reported below show the results for the several meters



Short baseline test for Scintrex CG5 40966

The long baseline test is usually carried on two bases of the network. The showed results come from readings performed between bases 9000 and 9001.

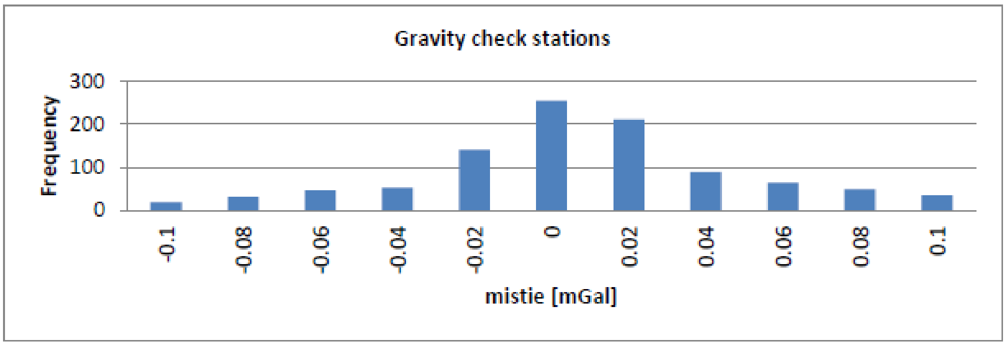


Long baseline test for Scintrex CG540966

Pre-survey	Instrument tests	May 15th
During-survey	Instrument tests Layout parameters	Every week Field books daily compiled. Scintrex data digitally stored Values chheck between consecutive measurements executed at the same station
Post-survey	Field office control measure	Data transfer/download daily on survey database, loop closure check, data conversion to Obs Gravity, Mistie check , Outliers /instrumental tares Check. Correlation check with topography

Number of Gravity re-surveyed stations:	**998**
Standard deviation in measured gravity:	0.042
Average difference:	0.002

The following graphic shows statistic of repeated station mistie



GRAVITY BASE NETWORK

The gravity **Base N**etwork includes thirtyeight base-stations and 66 double runs (A-B-A-B-A) ties on 30 polygons. Each base was connected with at least 2 other bases (average of 3.5 ties for each base) for better error compensation

Proprietary ElevNet software was then used to compute the final adjustment and obtain a well-compensated base network, using all the individual ties. Absolute Gravity value was transferred to the area using a gravity base located in the small town of Elliot (Absolute Gravity Base 1029 – Elliot, Observed Gravity 978426.793 (mGal) ISOGAL84. This station has been established in the area during a previous gravity survey using the AFGN 1967930134 at the

Tennant Creek Airport .he absolute gravity point was introduced as eccentric point and directly connected to the closest station of the network (9027).

The absolute reference station is located approximately 1.2 km north of the Elliot Hotel, on the left hand side of the Stuart Highway adjacent to the cattle grid at the main entrance to the cattle yards. The base consists of a small star picket protruding from the ground and is witnessed by a Daishsat survey plaque, placed on a large star picket ~ 0.3m to the right.

Absolute Gravity Base 1029 – Elliot

Observed Gravity
978426.793
ISOGAL84 (mGal)

Photo of Elliot base 1029 showing distinguishing features in the background

The Base Stations of the network were built as concrete slab with dimensions of 30x30cm. The Base Stations of the gravity network were used during the acquisition as reference points to improve the quality of the drift estimation and data reduction.

. Base station 9008

GRAVITY DATA PROCESSING

Importing all the gravity data into WinGLink software utility, the readings at each station were corrected for residual (linear) meter drift through the repeated base station readings . Meter drift was normally below 0.1 mGal . Loops showing bigger fluctuation drift were re-observed.

The combined gravitational effect of the Sun and Moon at the Earth's surface was computed by the "WinGLink" utility, using the I.M.Longman,1959 formula. The tidal gravity correction was thus applied to the L&R gravity meters readings. Scintrex CG-5 gravimeter automatically includes tidal correction computation based on stored meter position coordinates.

Observed gravity data (Gobs) files were exported from each day's runs and imported to the WinGLink project database along with the stations coordinates from dGPS survey.

GRAVITY REDUCTIONS

Using WinGLink, observed gravity values were reduced to free-air and Bouguer anomalies using standards methods. Additional refinements include the use of a curvature correction to the simple Bouguer anomaly (Bullard B correction); this correction accounts for earth sphericity.

FREE-AIR ANOMALY

The free-air anomaly was computed by calculating the theoretical gravity field at the position of the gravity station, then subtracting the theoretical field from the observed gravity. The theoretical gravity field is a function of latitude and elevation.

The free-air anomaly is calculated using the following formula:

$$\Delta g_{FA} = g_{Obs} - g_T + 0.3086\ H$$

Where:

g_{Obs} is the observed gravity

g_T is the normal gravity on the ellipsoid at that latitude and computed using the 1980 International Gravity Formula

H is the height of the meter above the geoid

BOUGUER ANOMALY

The classical Bouguer reduction is a three-step procedure (Swick, 1942, LaFehr, 1991):

- apply the Simple Bouguer slab formula (Bullard A)
- add a curvature correction (Bullard B)
- apply a terrain correction for departures of the actual Earth's surface from an idealized spherical surface (Bullard C)

The first two are functions of elevation and topographic density only, while the third is, in addition, a function of surrounding topography.

The infinite slab term is given by $2\pi G\rho h$ (G being the Newton's gravitational constant) and is almost always larger than the terrain correction and is always larger than the curvature correction.

The curvature correction is calculated by computing the gravitational effect of a spherical cap with a linear radius of 166.7 km (outer radius Hayford-Bowie system). The spherical cap produces a lesser effect than the infinite slab because of the "truncation" of that part of the slab above the earth and extending to infinity, but it produces a greater effect than the slab because of subslab earth resulting from curvature. The physical significance of the correction lies in the combination of these two differences, which are each a function of elevation (LaFehr, 1991).

The calculated terrain correction is added to the Simple Bouguer anomaly to provide the so-called Complete Bouguer Anomaly and should include the effect of terrain departures from the horizontal from the location of the station to a large distance, typically 167 km (1.5°).

Because the Bouguer Correction BC may be written:

$$BC = g_{slab} + g_{cc} + g_{TC}$$

Where: $g_{slab} = 0.0418\rho H$, g_{cc} = curvature correction, and g_{TC} = the terrain correction.

The Bouguer anomaly Δg_{BA} is then given by

$$\Delta g_{BA} = \Delta g_{FA} - (g_{slab} + g_{cc} + g_{tc}).$$

Since the survey area is almost flat, only the Outer Terrain Corrections was applied. This Outer Terrain Correction was calculated by using:

- SRTM 100m DEM (from 0m to 10,000 m radius)
- SRTM 500m DEM (from 10,000m to 167,000 m radius).