# GRAVITY AND MAGNETIC PROFILE FROM CAMPERVILLE TO THE SASKATCHEWAN BORDER (PARTS OF NTS 62N/E AND 63C/E)

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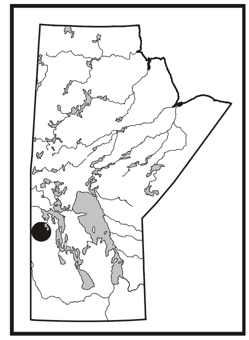

Surasky, A.T. and Minkus, R.S. 2000: Gravity and magnetic profile from Camperville to the Saskatchewan border (parts of NTS 62N/E and 63C/E); *in* Report of Activities 2000, Manitoba Industry, Trade and Mines, Manitoba Geological Survey, p. 210-213.

## SUMMARY

In May 2000, a reconnaissance gravity survey was carried out in the vicinity of the Camperville gravity low in west-central Manitoba (Bamburak et al., GS-32, this volume). The purpose of this survey was to verify the presence of a gravity low in the area. In the present study, a more detailed gravity and magnetic survey was carried out along a line from Camperville to the Saskatchewan border, transecting the area of the gravity low.

## INTRODUCTION

Gravity and magnetic surveys were completed during a five-day period, starting June 8, in the vicinity of the Camperville gravity low in west-central Manitoba. The purpose was to obtain a more detailed view of the gravity and magnetic field in the area. The surveys were carried out along Provincial Trunk Highway (PTH) 20, PTH 10 and Provincial Road (PR) 275, from Camperville to the Saskatchewan border. The survey area is shown in Figure GS-33-1.

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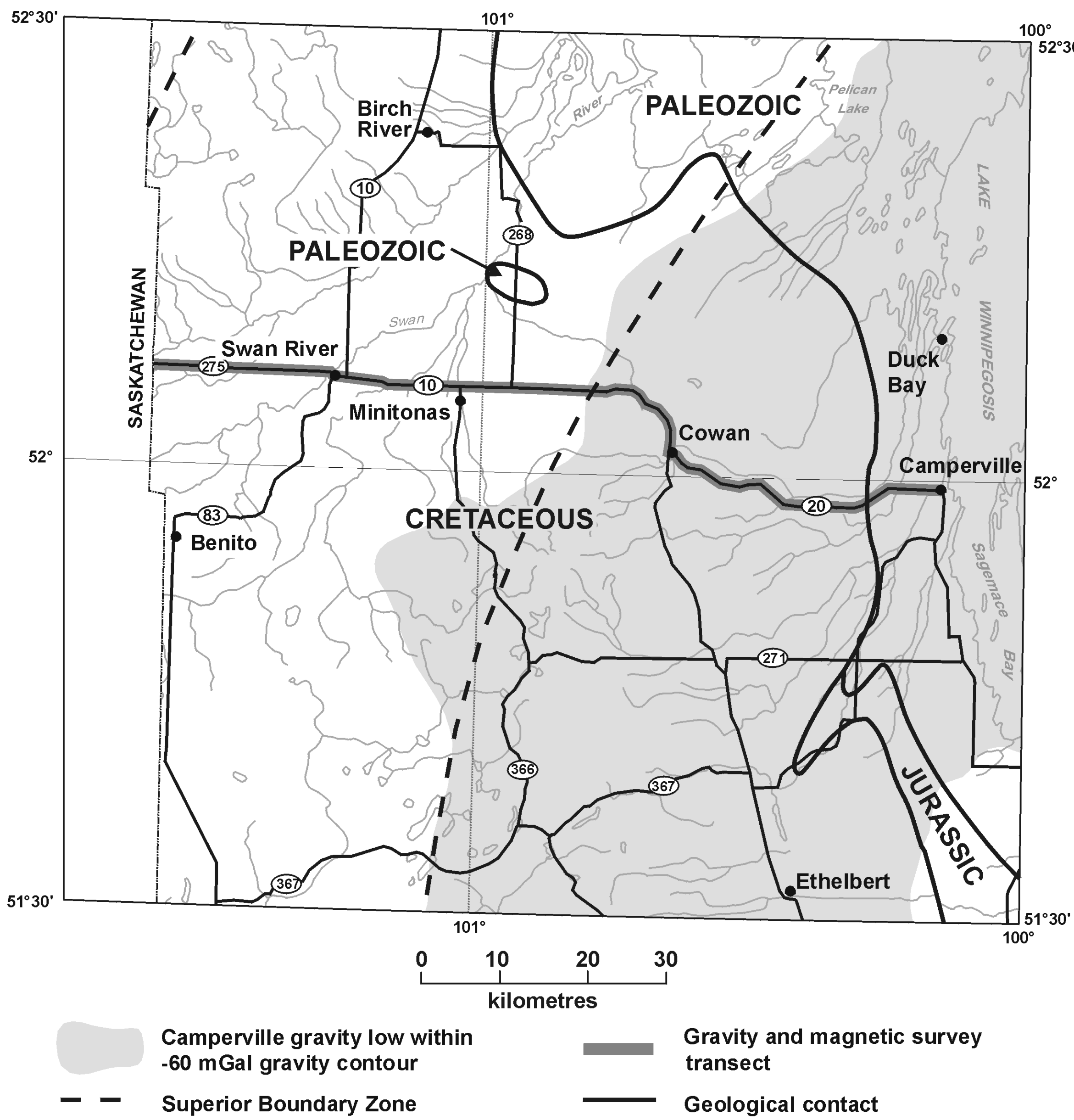


*Figure GS-33-1: Map of survey area.*

## GEOPHYSICAL SURVEYS

### Gravity Survey

The gravity survey was completed using a Worden™ gravity meter (model III, no. 543, built by Texas Instruments), with a sensitivity of 0.04 mGal, belonging to the Department of Geological Sciences, University of Manitoba. Readings were taken in the ditch, adjacent to the highways, at 1 km intervals. The gravity meter was situated on a tripod approximately 50 cm off the ground when the readings were taken. The gravity survey used a base station in order to correct for drift. The base station was visited approximately every two hours.

The site position was recorded using a Garmin 12 CX GPS system. As the elevation data from the GPS system are not sufficiently accurate for gravity surveying, station heights relative to the centre of the highway were recorded.

The elevation data were obtained using highway profile maps from the Manitoba Department of Highways and Government Services. Since the highway profiles contain the elevation data for the highways, the station was located on the highway profile and the elevation was read off the profile. The difference in height between the highway centreline and the station was subtracted from the elevation determined from the highway profile, giving the actual elevation of the station.

#### *Data Reductions*

Gravity data need to be reduced so that only lateral subsurface density variations are represented by the data (Reynolds, 1997). In the processing of the gravity data, the following corrections were made in order to reduce the data to the Bouguer anomaly:

- Drift correction (using repeat base station readings)
- Free-air correction

  $dg_F = 3.086h$ where h is the height differential between stations, and $dg_F$ is in gravity units (g.u.)
- Bouguer correction

  $dg_B = 2pGrh$ where G = $6.67 \times 10^{-8}\ m^3 \cdot Mg^{-1} \cdot s^{-2}$, r = density (a density of 2.67 $Mg \cdot m^{-3}$ [2670 $kg \cdot m^{-3}$] was assumed), $dg_B$ is in g.u.
- Latitude correction

  $dg_L = -8.108\sin(2f)$ where f is degrees of latitude, $dg_L$ is in g.u./km

The terrain correction was not applied because the survey area had limited relief and, with the assumed density, the correction was negligible.

#### *Results*

The Bouguer gravity anomaly profile is shown in Figure GS-33-2. There is a definite decrease in gravity progressing from west to east. There is a 60 mGal (600 g.u.) change over the length of the survey. There is an increase of approximately 10 mGal (100 g.u.) in the Bouguer anomaly between 350000m east and 375000m east. There are also shorter wavelength (<10 km) and smaller amplitude (<3 mGal) variations toward the eastern end of the survey (Fig. GS-33-3).

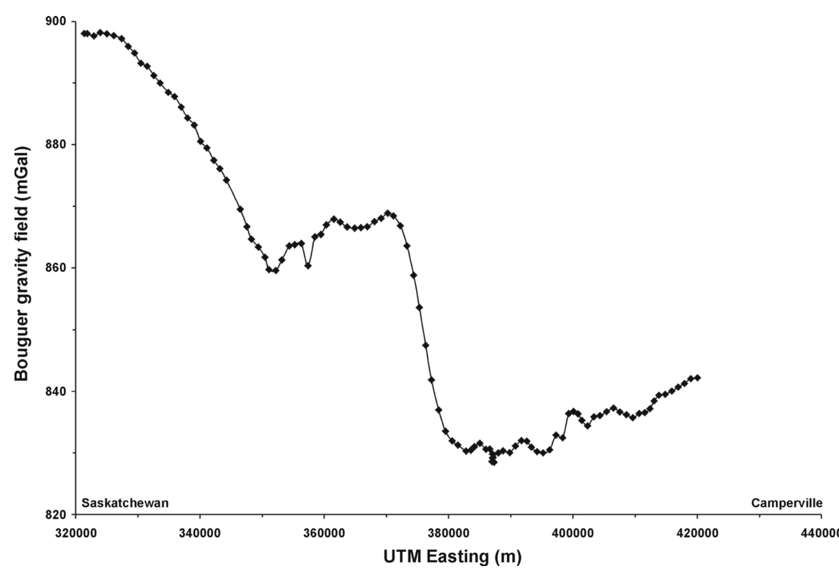


*Figure GS-33-2: Profile of the Bouguer gravity anomaly showing a general rise in gravity from east to west.*

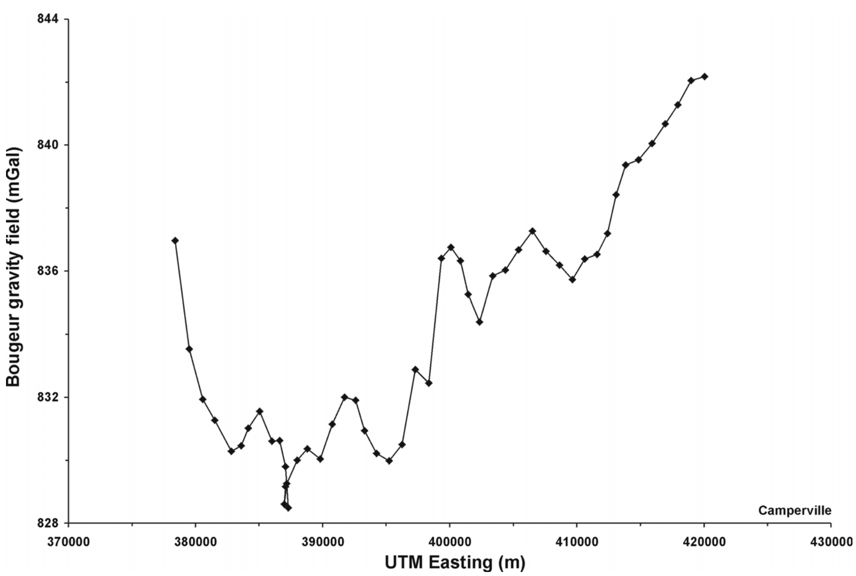


*Figure GS-33-3: Enlargement of the Bouguer gravity anomaly for the eastern 50 km of the transect, showing shorter wavelength and smaller amplitude responses.*

*Modelling*

Some preliminary two-dimensional modelling of the gravity data was done using the computer program Potent™, produced by PC Potentials. A constant average value was subtracted from the data prior to modelling. The aim of the modelling was to derive a simple model that fit the data. The model consisted of three polygonal prisms located within the upper crust. The data were fitted by iteratively adjusting the density of the bodies and the apices of the polygons. The final model is shown in Figure GS-33-4. The data were well fitted by the three bodies. The final density contrast of the bodies is +0.17, +0.20 and -0.10 Mg•m$^{-3}$ with respect to the background density. This model is just preliminary but, if the true geological source of the anomalies has a size similar to the polygons, the observed anomalies can be explained by a density contrast on the order of 0.20 Mg•m$^{-3}$.

## Magnetic Survey

The magnetic survey was completed using the Scintrex MP-4 proton precession magnetometer and the IGS-2, both with a sensitivity of 1 nT and belonging to the Department of Geological Sciences, University of Manitoba. Total magnetic field readings were taken at the same stations as the gravity measurements. Two total magnetic field readings were taken at each station. A magnetic base station was used, and was revisited approximately every two hours. Due to an instrument malfunction, the magnetic survey could not be completed in June, and was instead completed in late August (Bamburak et al., GS-32, this volume). Repeat measurements at common stations from both surveys showed good correlation between the data.

*Data Reductions*

The magnetic field drift was removed from the June data by using total magnetic field repeat readings taken at the base station. However, for the data collected in August (stations 49–104), the magnetic diurnal variation was negligible and was not removed.

*Results*

The total magnetic field profile is shown in Figure GS-33-5, and an enlargement of the eastern 50 km is shown in Figure GS-33-6. There appears to be a general rise in the magnetic field from west to east, but the magnetic response is not as smooth as the gravitational response. Initial comparison of the Bouguer gravity anomaly and total magnetic field suggest an inverse correlation.

Future work will include modelling of the total magnetic field data, and joint modelling of the Bouguer anomaly and the total magnetic field.

## REFERENCES


Reynolds, John M. 1997: Introduction to Applied and Environmental Geophysics; John Wiley & Sons Ltd., West Sussex, England, p. 31 – 116.


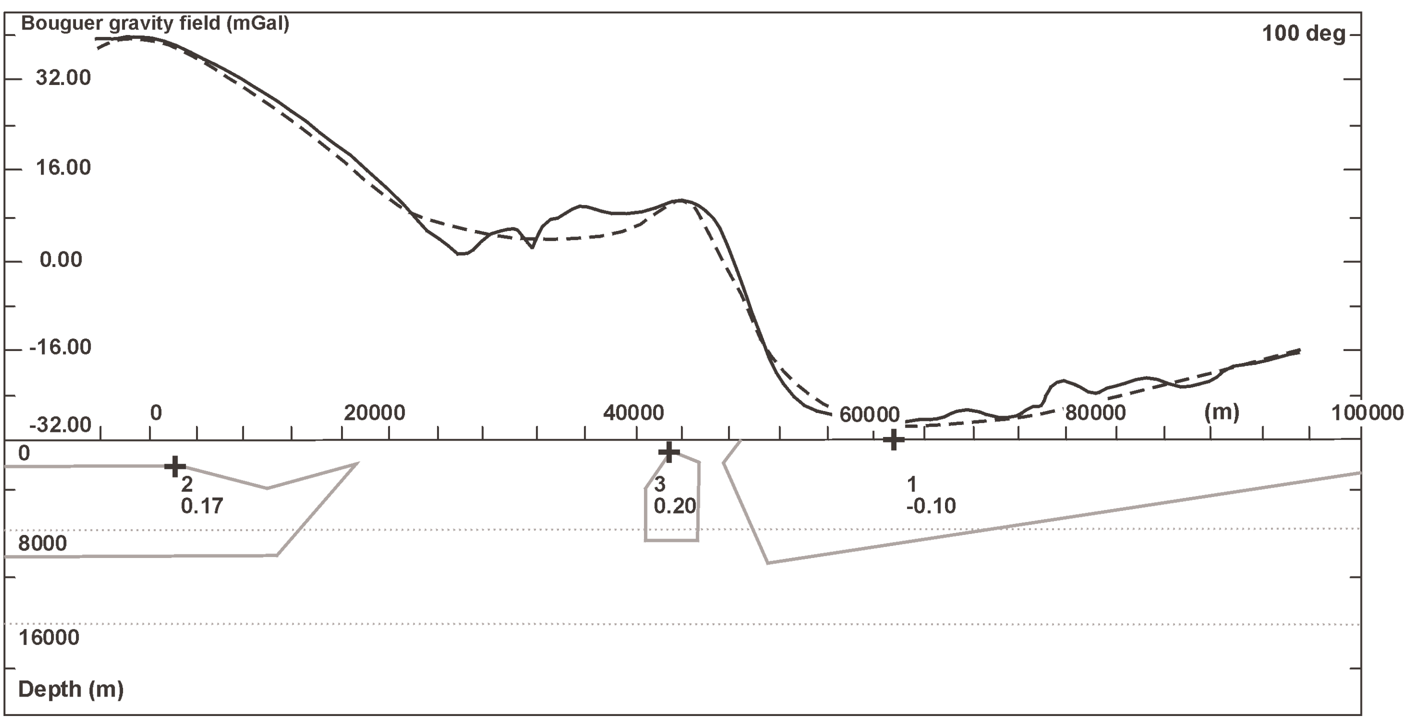


*Figure GS-33-4: Preliminary model fitted to the data. The model consists of three upper crustal bodies with density contrasts of +0.17, +0.20 and -0.10 Mg•m$^{-3}$ with respect to the background density.*

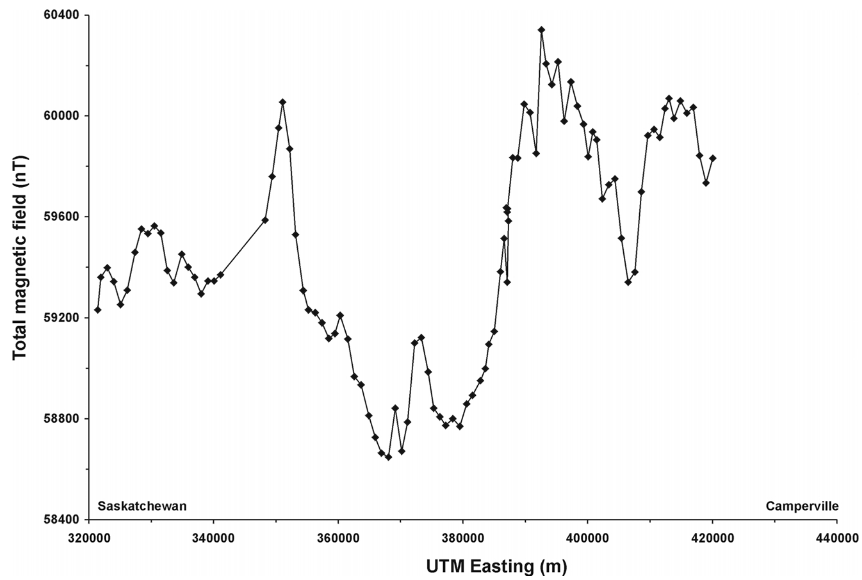


*Figure GS-33-5: Profile of total magnetic field response showing an inverse relation to the Bouguer gravity anomaly.*

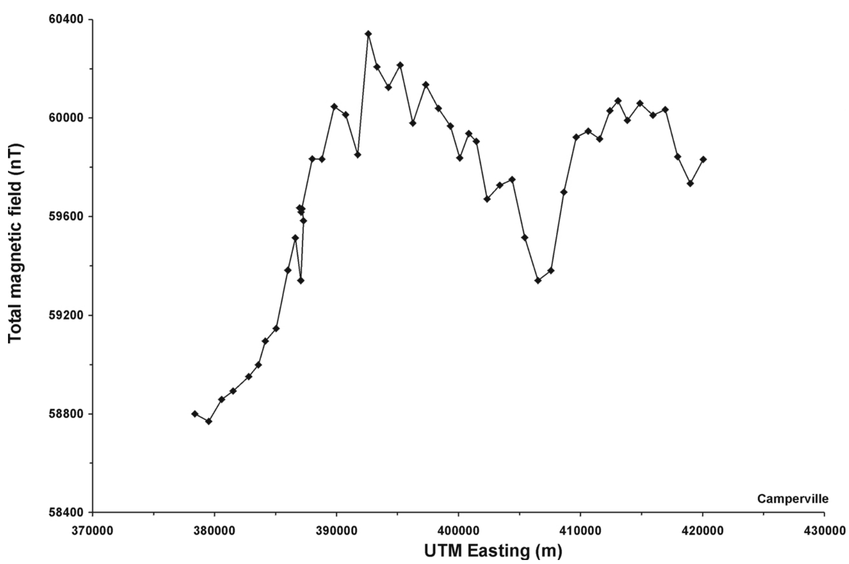


*Figure GS-33-6: Enlargement of the total magnetic field response for the eastern 50 km of the transect.*