1. TITLE

BOREHOLE GRAVITY SURVEY AT LALOR, MANITOBA

2. BACKGROUND AND OBJECTIVES

Borehole gravimeters (BHGM) have been around for many years in the oil industry, but recently a new gravimeter was developed to perform measurements in slim mining boreholes. Using the borehole data, the depth resolution of surface inversion can be improved to enhance the effectiveness of gravimetric surveys for deep exploration.

One of the advantages of the BHGM as a density logging tool is that it is practically unaffected by nearhole influences: casing, poor cement bonding, rugosity, washouts and fluid invasion. For this project, we are expecting a precision of 5 MicroGal which can detect small density variations around the borehole. The borehole gravity data should help to constrain the location of the ore zones and of the footwall-hanging wall contact hosting the Lalor deposit. Figure 1 shows one of the applications of borehole gravity measurements to improve the 3D inversion and interpretation of ground gravity surveys. By varying the data acquisition parameters and comparing an inverted model calculated with these data to a known initial model, the optimal data acquisition settings can be determined for a VMS in a particular geological context. These parameters are the number of boreholes, their location and the data spacing in the borehole The estimated cost for the borehole gravity survey is 100,000 Can $.

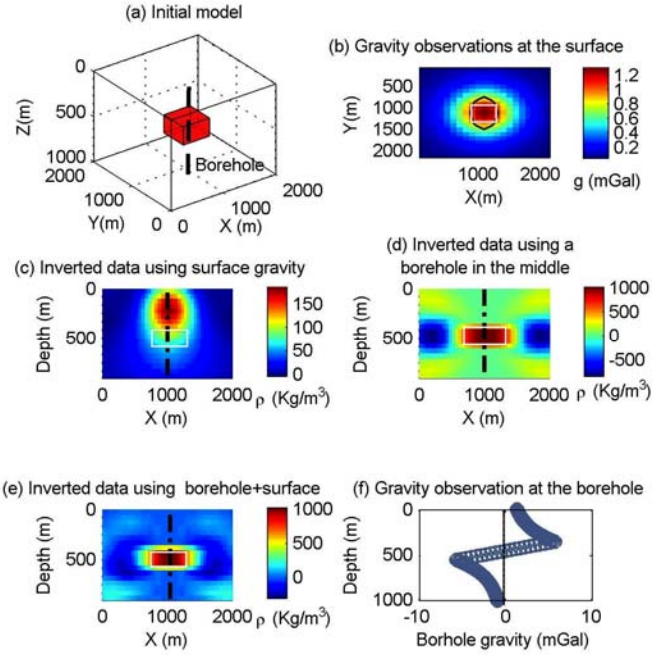

Figure 1: Improving 3D gravity inversion using borehole gravity measurements. The exact location of the body is indicated by the white rectangle in b), c), d), and e). Gravity inversion combining both surface and borehole data provide the most accurate results.

3. SCOPE

A gravity survey of four boreholes situated on the margin of the massive sulphide ore zone at Lalor is proposed. The boreholes are located close to HBMS Lalor mine site and are accessible through a drill road. The boreholes are approximately 300 to 950 m from the main mine road, a wide and well-maintained gravel road (Figure 2).

The exploration boreholes for the downhole gravity survey were drilled in 2011 and intersect hard crystalline rocks. These are open holes (un-cased) except over a thin un-consolidated overburden interval (about 5 m) near the surface. The diameter of the boreholes is NQ size (2.98 inch). The boreholes reach depths between 1500 to 1700m. The boreholes are steep (85 degrees) near the surface and dip about 75 degrees at their deepest points. The main zone of interest is a discontinuity located at a depth range of 800 - 1300 m.

The Contractor shall provide all of the necessary facilities, equipment, materials, competent and experienced crew to collect and deliver high quality borehole gravity measurements in a time-efficient manner.

4 DETAILED TECHNICAL SPECIFICATIONS

Number of boreholes: 4
Size of borehole: NQ size (2.98 inch)
Depth interval: surface to 1500 m on average
Sensitivity of instrument: <2 micro Gal
Deviation of vertical:<70 degrees
Number of readings: 103 readings for four drillholes.

The borehole sections in the hanging wall (approximately the top 600m) of the ore zone does not warrant the same level of detail as the section in the footwall. A sparse sampling interval of 100m spacing is proposed for the hanging wall starting with a reading on surface. Approaching the footwall the sampling interval decreases to 50m (two measurements) to finally reach a sampling interval of 20m in the footwall of the deposit.

5 TASK LIST AND IN FIELD DELIVERABLES:

Required tasks to be executed by the contractor are:

5.1 Permits

Obtaining all the necessary permits and clearances to do the work from the Federal, Provincial, Municipal, and other agencies. A work permit application has been filed to Manitoba Conservation for this work. It is expected that a work permit will be delivered to the Geological Survey of Canada before the beginning of the work. All other permits shall be obtained by the Contractor.

5.2 Equipment tests

Running the complete manufacturer recommended equipment tests before going into the field. All equipment should be checked according to manufacturer's specifications.

5.3 Data quality assurance

Shutting down the operation to ensure data quality, high quality control of both the acquisition system and recorded data, during significant equipment malfunction or during a significant decrease in signal-to-noise ratio due to high wind conditions, temporary mine noise, etc. The Contractors Observer is **responsible** for shutting down the operation under these circumstances and resuming operation when conditions improve.

5.4 Daily field survey

Creating and storing a detailed log of borehole depth range surveyed on a daily basis. These logs will be given to the TA in electronic form at the end of each day. Results, including plots, printouts, etc., of daily and other system tests, are deliverable items and may be inspected at any time during the survey. Surveyor's notes and Observer's logs are deliverable items, to be presented in digital format. Any **repeated** measurement is a deliverable item and should be presented in digital format.

5.5 Field survey report

Creating a detailed log of the following:

- The name and location of the survey data
- The name and address of the Contractor, the phone and fax numbers of the company
- The date of the survey
- A list of contents; a description of the survey's progress
- Copies of licenses and government approval documents
- A map showing the location of the recording borehole at a reasonable scale on a base showing pertinent cultural elements
- The text will include discussion of:
- The problems encountered during the survey and how they were dealt with (e.g., bad weather days, shut downs for instrumental problems, repeating the measurements, etc.)
- Details of subcontracting companies (e.g., surveyors, etc.)
- Details of the recording equipment used
- Details of the response functions of the field recording system, its filters, etc.
- Details of all processing and corrections (filtering, separation regional residual, terrain correction, etc.
- Details about processing for obtaining:

    - Digital field data
    - Quality Control processing

- Observed Gravity
- Free Air Corrected Gravity
- Residual Gravity Bulk Density

An annex will contain:

- Complete lists of testing equipment available (if any)
- Personnel list showing who was in charge for the survey over what time interval, Party Manager, Observer(s), etc.
- Complete equipment list.

5.6 Safety and environment

Providing and enforcing a safe work environment to all members of the field crew, including sub-contractors. The Contractor shall ensure that crew member have valid licenses or permits required to perform their specific task, have an Emergency Response Plan and use acquisition procedures and equipment minimizing the environ- mental impact of the survey. All health, safety, and environmental incidents shall be reported immediately to the TA. Daily logs shall include all health, safety, and environmental incidents and concerns (including near-miss) related to the Borehole gravity survey.

6. TRAVEL

The Contractor is responsible for the mobilization, and subsequent demobilization, of all equipment, materials, and field crew required for the downhole gravity survey to the borehole acquisition site in the Lalor Lake, Manitoba area. The contractor is responsible for room and board for is crew during travel and during the survey in Snow Lake.

7. SPECIAL CONSTRAINTS

The downhole gravity borehole survey is within the operational area of HBMS. As such, the borehole gravity data acquisition will have to be coordinated with HBMS who will provide safety orientation meeting and access to their private roads. Safety orientation (mandatory to every crew member) will include approximately 3 hours in Flin Flon, Manitoba, and approximately one and a half hour Snow Lake. In addition, the contractor will be required to release HBMS from any liabilities related to the borehole gravity data acquisition.

8. DELIVERABLES

The key deliverable of this work must include gravity surveys with clear and identi- fiable first breaks, demonstrating proper borehole gravity data acquisition. Detailed deliverables include:

- Observed gravity (including all repeated data)
- Survey files (all raw data)

- Free Air corrected gravity
- Bouger gravity
- Residual gravity
- Terrain corrected Bouguer gravity (if necessary)

9. SCHEDULE

The downhole gravity data acquisition shall be conducted during the time period of December 15, 2013 to March 21, 2014. All final deliverable items shall be received by **March 28, 2014.**

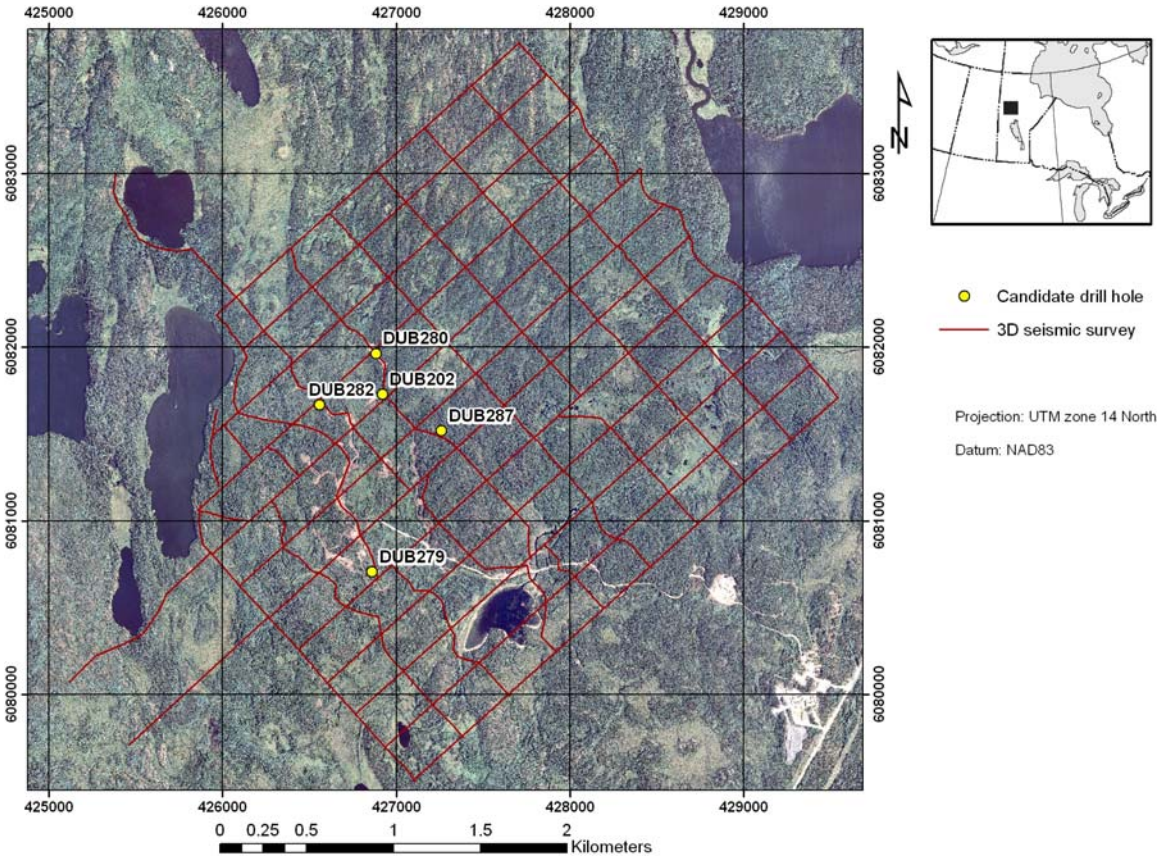

Figure 2 Location of the 5 candidate boreholes for conducting borehole gravity measurements

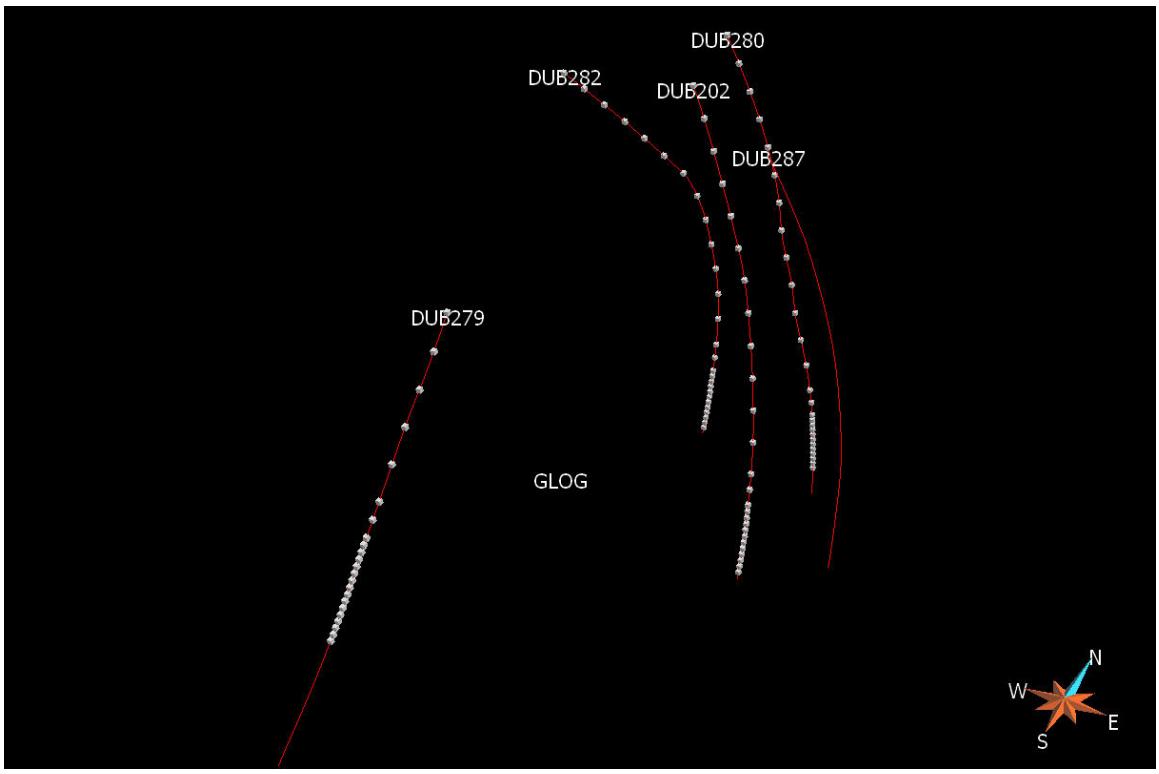

Figure 3: 3D perspective view of borehole gravity survey design for holes DUB202, DUB279, DUB280, DUB282 for a total of 103 samples. See Figure 2 for the location of these four boreholes.