ABITIBI GEOPHYSICS

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Geo-Echoes

A powerful and yet underestimated tool

An Abitibi Geophysics gravity specialist during a gravity survey in Tunisia. This regional survey, consisting of 4500 stations every kilometre was carried out in 2001 using Scintrex CG-3M microgravimeters and Leïca GPS receivers.

By precisely measuring the earth's gravitational field, **gravimetry** enables us to study geological formations using their densities. Gravimetry can help in mineral exploration at many levels:

- ***Regional level*** *: Geological and structural reconnaissance to focus on the areas of interest and determine the plausible deposit models*
  For example : Greenstone belts, Ultramafic rocks, Grantic batholiths, diapirs, calderas, volcanic domes, structural corridors, faults, etc.
- ***Local level*** *: Geological and structural mapping to directly delineate ore-bearing structures*
  For examples : skarns, horsts and grabens, brecchias, silicification, alteration or intense fracture zones, etc.
- ***Orebody level*** *: Direct detection of either excess or depletion of mass..*
  For example : VMS, Ni-Cu-PGE , Ti-Fe, Pb-Zn (Mississipi Valley),
  Fe-Cu-U-Au-Ag (Kiruna, Olympic Dam), or chromite deposits, etc.

Contrary to electric and electromagnetic methods, a conductive overburden **will not hide** the presence of a more or less massive sulfide orebody. The depth of investigation is a function of geometry of the target as well as its density contrast with the host rock. The density of massive sulfides can vary from 4 to 5 whereas the average density of rocks in the Canadian Shield is 2,67.

Normally, a gravity survey is invoiced on a per station basis. Therefore, it is very important that the **optimum density** of readings be correctly determined given the wavelengths of the expected anomalies.

Gravimetry	*Regional Level*	*Local Level*	*Orebody Level*
Grid :	Square	Square	Survey Grid
Reading Density :	500 m x 500 m to 1 Km x 1 Km	200 m x 200 m to 400 m x 400 m	25 m x 100 m to 50 m x 200 m
Expected Precision :	0,1 to 0,5 mGal	0,05 mGal	0,01 mGal
X, Y, Z Positioning:	DGPS (± 0,5 m) Barometric (± 3 m)	DGPS (± 25 cm)	DGPS or Total Station (± 5 cm)
Rate / station:	75 to 150 $	50 to 100 $	25 to 50 $

The Geo-Echoes are back! Here are some of the subjects that will be covered in our upcoming issues:

- Geophysical tools for diamond exploration.
- Continuous MAG and GPS surveys without the need for line cutting.
- Cross-Hole IP surveys

Every gravity survey must be carried out with a topographical survey. You can obtain the required elevation accuracy with a dual-frequency differential GPS survey without having to close your surveying loop. This is particularly useful in regional and local surveys. The caption above shows a GPS Leica system in action. A GPS base station is located less than 15 Km from the survey points. This base station is used for differential corrections either in real time or in post-processing

Rock/mineral	Average Density
Sandstone	2.25
Rhyolite	2.50
Andesite	2.60
Granite	2.65
Peridotite	3.15
Sphalerite	4.00
Chalcopyrite	4.20
Chromite	4.65
Pyrrhotite	4.65
Pyrite	5.15
Galena	7.50

Federal and Provincial government agencies normally carry out **regional** surveys. In the winter of 2001, the Ontario Geological Survey had 26 townships in the Timmins mining camp surveyed on kilometer square grid (OGS map 81-671). Following the publication of these results, less than two months after the work was completed, several small-scale gold and base metal surveys were carried out by private companies.

On a **local** level, complete coverage of a 20 km^2 property with a 250 m by 250 m square grid requires only 320 stations which amounts to an approximate all-inclusive cost of only **25 000 $**. With such a density of readings very few structures of mining interest or massive sulfides will be overlooked; being characterized by at least two readings. As a second step, follow-up grids could be established on the most promising targets for diamond drilling.

On the scale of a **deposit**, the gravity method has been proven to be very effective in following-up on isolated conductors such as MegaTEM anomalies. If the conductor is graphitic in nature, then no associated gravity high will be present. In order to detect this gravity anomaly, only a single 1-Km long profile, with readings every 50 m at each end of the profile and every 25 in the center of the profile, is required.

We strongly recommend that a **resistivity imaging** survey be carried out with each detailed gravity survey, in order to correct the effect of overburden thickness variations. In the past, the seismic method was the preferred method for overburden thickness investigation. However, its prohibitive cost limited its use. The development of high performance resistivity imaging systems has enabled the resurgence of detailed gravity surveys because these overburden effects, which can seriously affect the interpretation of gravity data, can now be removed. The overall cost of a detailed gravity survey with overburden thickness investigation using resistivity imaging is approximately **2 500 $.**

A gravity crew normally consists of two operators: a gravity technician and an expert GPS surveyor. Several crews can operate at the same time without interfering with each other, thereby spreading the cost of the GPS base station over several crews. For instance, a 320-point survey on a 250 m square grid can be completed in **four days** with the final interpretation report delivered 10 days after the crew has demobilized.

Gravity is probably the most underestimated ground geophysical method. **Do we know enough about what is hidden in our mining properties to pass up on this method?** If you have any doubts, ask your geophysical consultant to investigate with you the gravity potential of your property.

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