



GEM Advanced Magnetometers
52 West Beaver Creek Road West, Suite 14
Richmond Hill, ON Canada L4B 1L9
Ph. 905-764-8008 Fax. 905-764-2949
info@gemsys.on.ca www.gemsys.ca

Depth Estimation Using Magnetometers and Gradiometers

One of the questions that our users most typically ask is, "How deep can a magnetometer see?". This can be a challenging question to answer without knowing much about the target. However, there are a set of general rules and methods that can provide you with depth estimates quite rapidly.

First, we look at the general set of equations for the total field and gradient. The total field (due to a dipole) is measured by:

$$T = 2M / r^3$$

Where M is the magnetic moment and r is the radius to the source. Similarly, for the response of a gradiometer to a dipole, we see that:

$$dT / dr = - 3M / r^4$$

where dT / dr is the gradient with respect to distance r.

The first point to notice is that the total field and gradient anomalies are dominated by the radius term; hence this is the most important parameter in determining whether a specific anomaly will provide a reading that is measureable with specific equipment. The second point to notice is that depth estimation methods differ depending on whether the total field or gradient is used.

For the total field, depth is estimated using half-width or nomogram values, or modeling. A sample nomogram is provided below for review.

For the gradient, depth is estimated as follows:

$$r = -3T / (dT / dr)$$

where T is the total field. Here that we see that it is possible to calculate the depth directly without considering the magnetic moment (which is often undefined in practice).



GEM Advanced Magnetometers
52 West Beaver Creek Road West, Suite 14
Richmond Hill, ON Canada L4B 1L9
Ph. 905-764-8008 Fax. 905-764-2949
info@gemsys.on.ca www.gemsys.ca

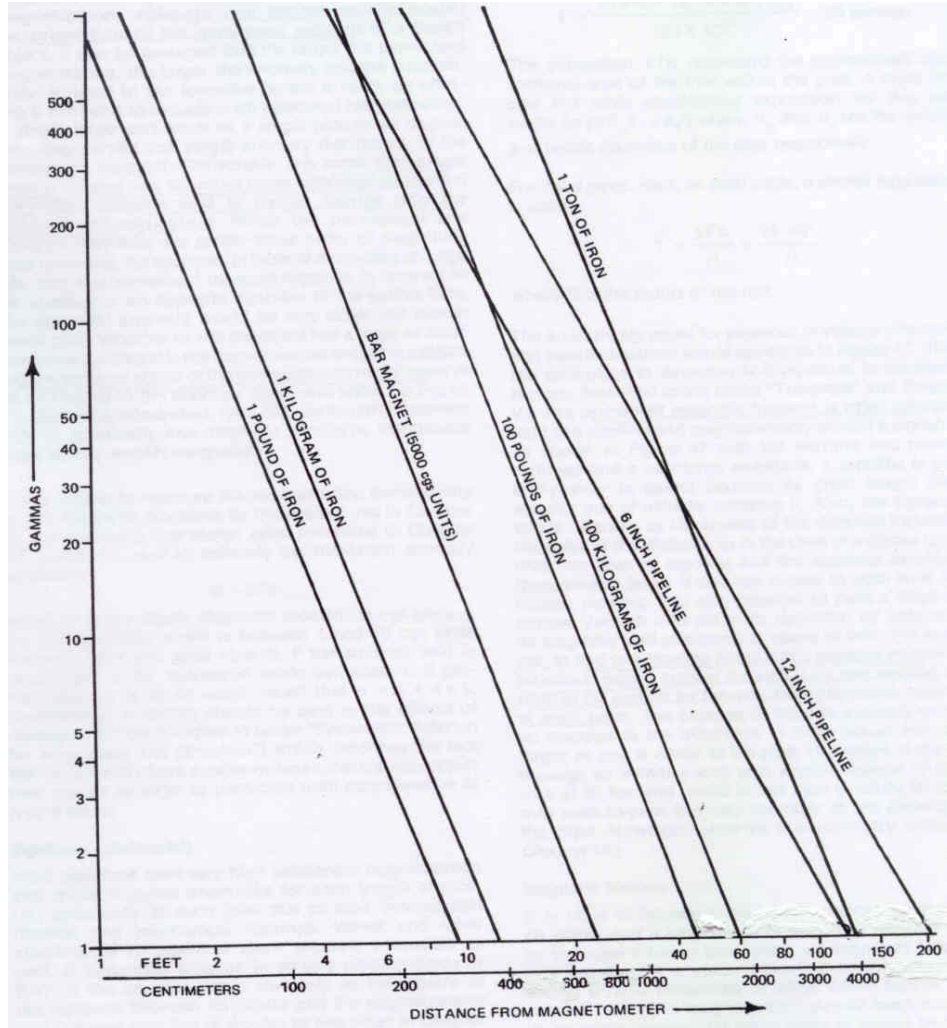


Figure 1. The nomogram enables you to specify a depth and type of anomaly, and the corresponding total field value is shown on the left abscissa. From Applications Manual for Portable Magnetometers. Sheldon Breiner, 1973.

In summary, there are a variety of methods for calculating depths particularly for the total field results. Numerical modeling is also a valid means of extracting depths, for example, by performing a forward modeling exercise before a survey. GEM's GEMLinkW has a simple modeling routine built in for this purpose. Unlike a total field magnetometer, a gradiometer produces a direct result; hence its usefulness for many types of near surface surveys.