Interpretação 4

Amplitude do Sinal Analítico

Ou

ASA

Amplitude do Sinal Analítico

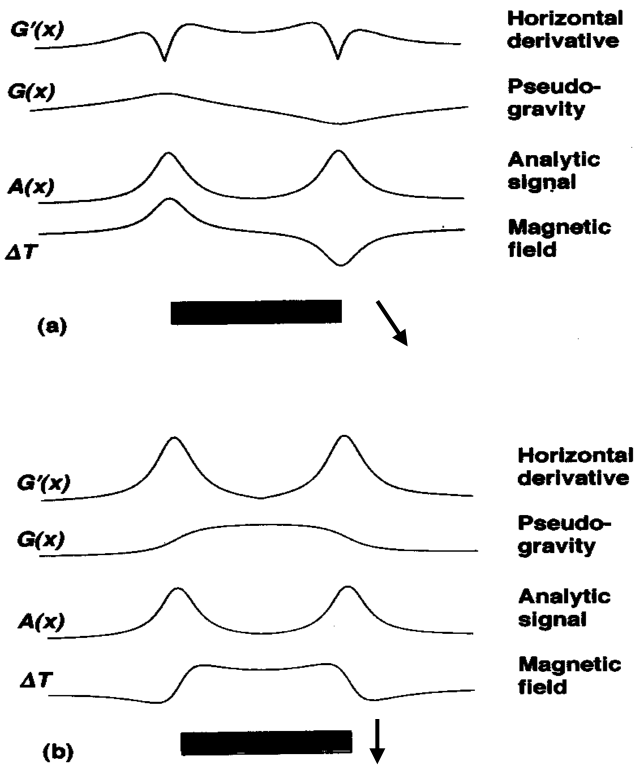
- Vários métodos têm sido propostos para a determinação da largura e profundidade dos corpos causadores de anomalias magnéticas; a maior parte, porém, dependem dos parâmetros do campo magnético indutor e da direção de magnetização do corpo.

- A amplitude do sinal analítico 3D ao longo de estruturas lineares, tem a vantagem de preservar a forma independente dos parâmetros locais do campo magnético e da magnetização da fonte. Isto é particularmente importante quando os corpos causadores de anomalias magnéticas possuem magnetização remanescente, cujos parâmetros normalmente são desconhecidos a princípio.

Amplitude do Sinal Analítico

$$|A(x,y,z)| = \sqrt{\left|\frac{dT}{dx}\right|^2 + \left|\frac{dT}{dy}\right|^2 + \left|\frac{dT}{dz}\right|^2}$$

$|A(x,y)|$ é a amplitude do sinal analítico em (x,y) e T é o campo observado em (x,y).



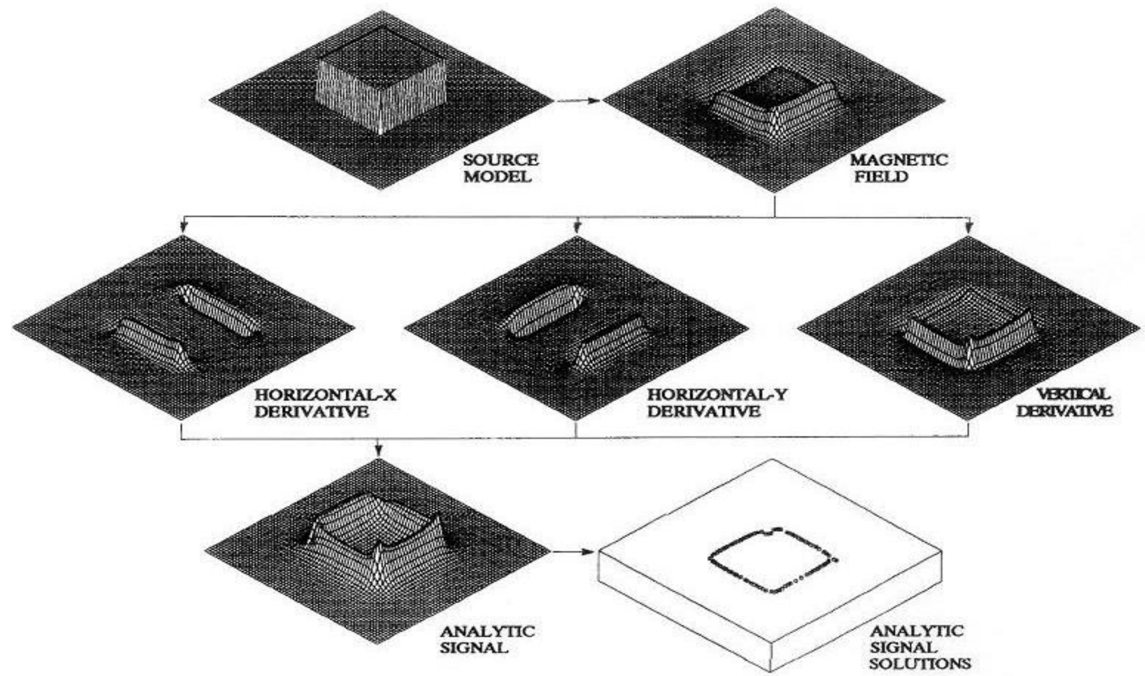


FIG. 1. Schematic outline of the analytic signal method. Horizontal and vertical derivatives are calculated from the total field anomaly over a square prism and combined to yield the absolute value of the analytic signal. The locations of the maxima and the shape of this signal can then be used to find body edges and corresponding depth estimates.

Sinal analítico e a meia largura

O módulo do sinal analítico 3D pode ser usado para determinar a posição das bordas do corpo causador da anomalia, e permite também uma estimativa da profundidade do corpo, geralmente a partir da meia-largura da anomalia magnética:

For a contact:

$$x_{1/2} = 2\sqrt{3}h = 3.46h$$

Equation 8

For a thin sheet (dyke):

$$x_{1/2} = 2h$$

Equation 9

For a horizontal cylinder:

$$x_{1/2} = 2(\sqrt[3]{4} - 1)^{1/2} h = 1.533h$$

Equation 10

For a thin sheet (dyke):

$$\frac{d^2|A(x)|}{dx^2} = \alpha \frac{2(3x^2 - h^2)}{(h^2 + x^2)^3}$$

Equation 13

$$x_i = \frac{2}{\sqrt{3}} h = 1.155h$$

Equation 14

For a horizontal cylinder:

$$\frac{d^2|A(x)|}{dx^2} = \alpha \frac{6(4x^2 - h^2)}{(h^2 + x^2)^{\frac{7}{2}}}$$

Equation 15

$X_i = h$ equation 16

Where:

A	is the analytic signal calculated from (3)
α	is the amplitude factor from (5)
h	is the depth
x_i	is the width of the anomaly between inflection points

Although we have not mathematically solved for a vertical cylinder, model tests show that results are very close the those predicted by Equation 16.

Apesar de geralmente apresentar bons resultados, a técnica do sinal analítico pode trazer problemas quando se tem várias anomalias muito próximas que interferem no sinal individual e não permitem uma boa estimativa da localização e da profundidade do corpo.

Para uma boa estimativa da profundidade, é necessário também utilizar a fórmula adequada, ou seja, conhecer a geometria do corpo que se deseja determinar.

Table 3.2 *Magnetic anomaly formulas and depth rules for simplified sources with magnetization in vertical direction. Empirical depth rules for vertical prism and long tabular models are included.*

Source	Magnetic anomaly (ΔZ)	Depth rule
Sphere (dipole) (see Fig. 3.15)	$\Delta Z = cM(2z^2 - x^2)/(x^2+z^2)^{5/2}$ (where $M = \frac{4}{3}\pi R^3 \Delta J_z$)	$z = 2x_{1/2}$
Long horizontal cylinder (line of dipoles, Fig. 3.15)	$\Delta Z = 2c\pi R^2 \Delta J_z (z^2 - x^2)/(z^2+x^2)^2$	$z = 1.75x_{1/2}$
Thin vertical cylinder (monopole)	$\Delta Z = c\pi R^2 \Delta J_z \frac{z_1}{(x^2+z_1^2)^{3/2}}$	$z_1 = 1.3x_{1/2}$
Vertical thin sheet (line of monopoles, Fig. 3.16)	$\Delta Z = 2c\Delta J_z t \frac{z_1}{(x^2+z_1^2)}$	$z_1 = x_{1/2}$
Vertical fault (Fig. 3.17)	$\Delta Z = 2c\Delta J_z \left\| \frac{\pi}{2} - \tan^{-1}\left(\frac{x}{z}\right) \right\|_{z_1}^{z_2}$	$z = 2x_{1/2}$
Vertical contact (fault) (with infinite throw)	$\Delta Z = 2c\pi \Delta J_z$	
Long tabular prism (two-dimensional)	see Appendix C	$h \approx s/0.65$ (see Fig. 3.18)
Vertical prism (Fig. 3.18)	see Appendix C	$h \approx s/1.1$, $h \approx p/1.75$
Finite cylinder (vertical or horizontal)	see Appendix B	

Note:
ΔZ is the vertical component of the magnetic anomaly (in nT); $c = 100$; x is the horizontal distance along the profile; ΔJ_z is the magnetization contrast (A/m) that can be obtained from the susceptibility contrast using Eq.(3.13); z is depth to the center of the body; z_1 and z_2 are depths to the top and bottom of the body, respectively; t is the thickness of the sheet (Fig. 3.16); $x_{1/2}$ is the half-width of the anomaly (defined in Figs. 3.15 and 3.17); s and p are the 'straight-slope' and 'half-slope' parameters (defined in Fig. 3.18), and h is depth to the top of the vertical prism or tabular prism.

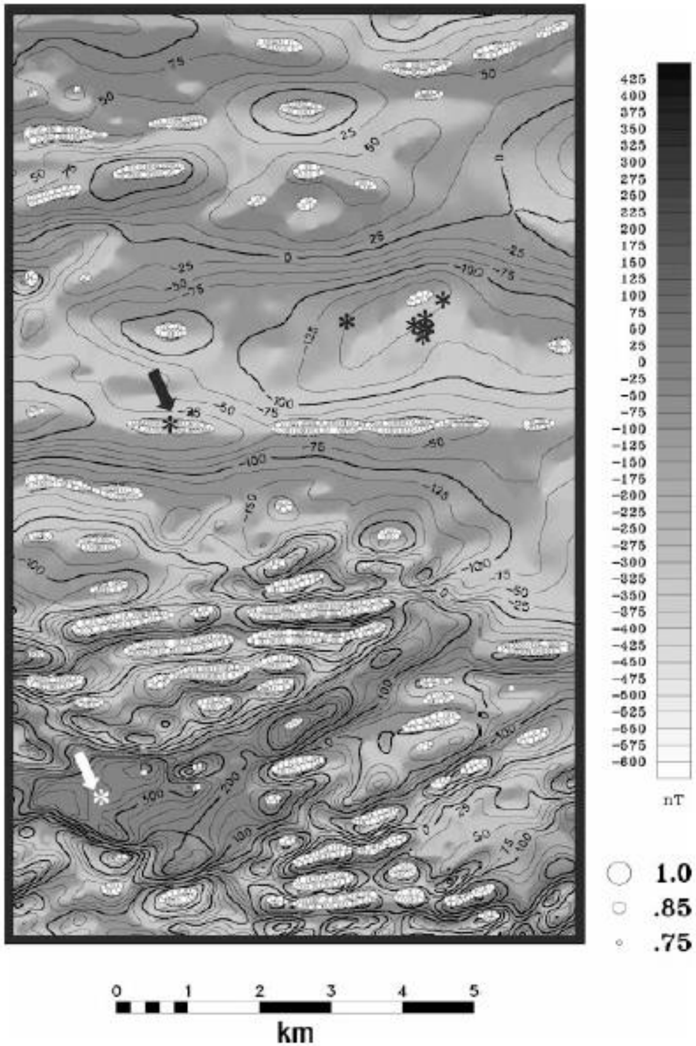


FIG. 7. Total magnetic field of the area discussed in the text. Known kimberlite pipes are indicated by arrows; locations where known alluvial diamond are found are indicated by an asterisk. Solutions where the correlation coefficient is larger than 0.75 are shown as circles. Circle diameter is proportional to the value of the correlation coefficients. Minimum contour interval is 25 nT; shading is from the north.

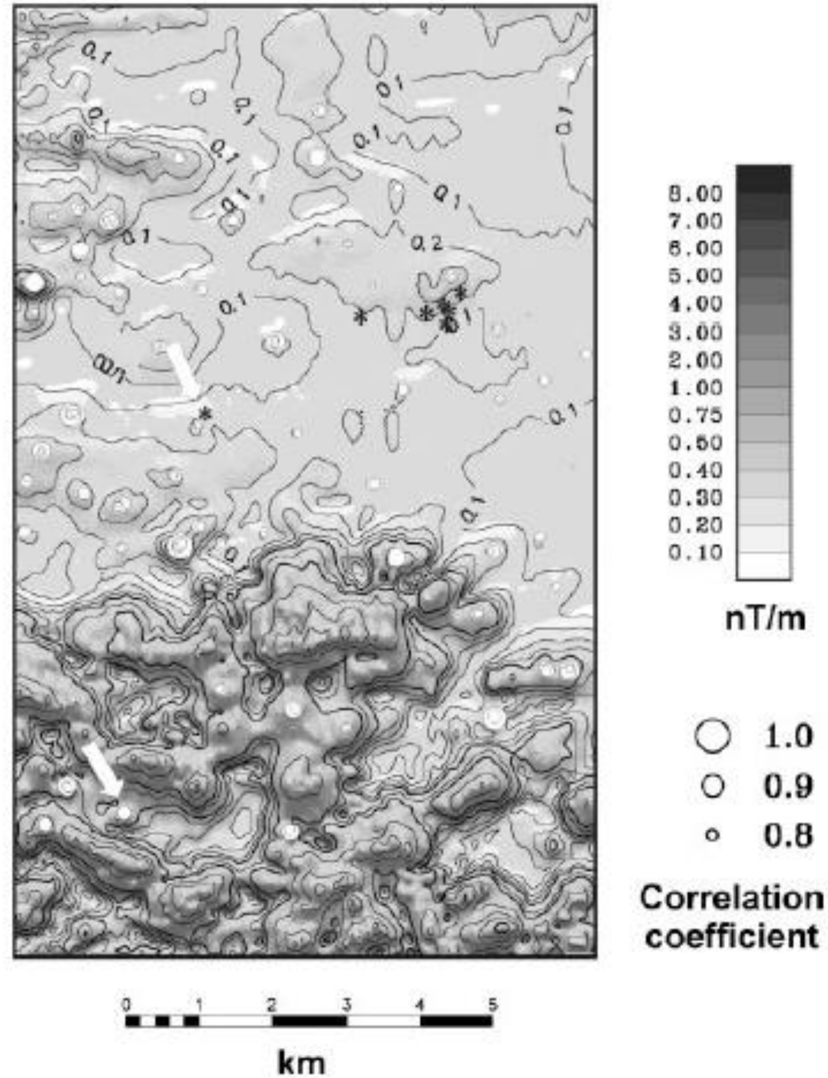


FIG. 8. Analytic signal of the magnetic field shown in Figure 7. Known kimberlite pipes are indicated by arrows. Solutions where the correlation coefficient is larger than 0.75 are shown as circles. Circle diameter is proportional to the value of the correlation coefficients. Minimum contour interval is 0.1 nT/m; shading is from the north.

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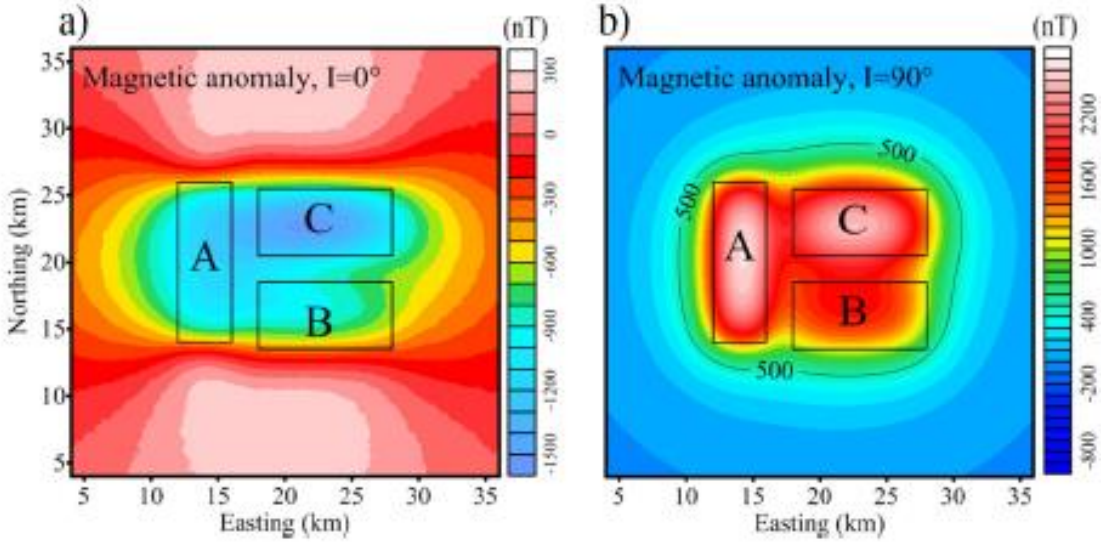

Fig. 3. The synthetic model data set. The model locations are indicated by the black lines. (a) The magnetic response with an inclination of 0° and a declination of 0°. (b) The magnetic response with an inclination of 90° and a declination of 0°.

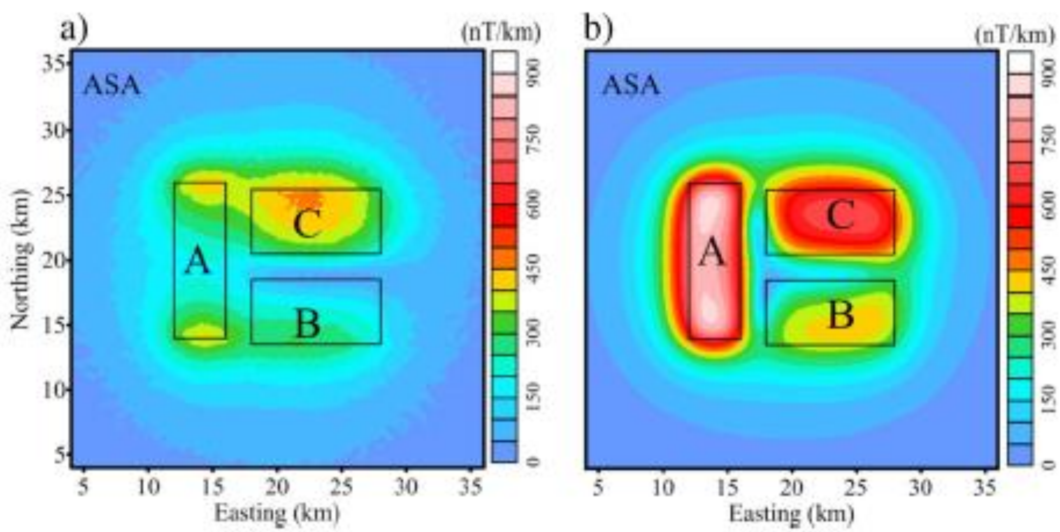

Fig. 4. The analytic signal amplitude (ASA) results corresponding to Figs. 3a and 3b.

Muitos corpos próximos que podem interferir